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This thesis examines cost reporting at a Navy Branch Medical Clinic. Costs are traditionally reported under a partial cost reporting system. By applying basic principles of managerial accounting, a full cost reporting system is created. Under the traditional system, one figure representing total consumption for each quarter is reported for each workcenter. Under the full costing model, costs are disaggregated into fixed and variable components. Using the Brimson approach, the thesis further explores the application of activity based cost reporting. Costs are reported as a function of the activities which drive costs.

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COST REPORTING AT A NAVY BRANCH MEDICAL CLINIC

by

James B. Canby IV
Lieutenant, United States Navy
B.S., Golden Gate University, 1983

Submitted in partial fulfillment
of the requirements for the degree of

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from the

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ABSTRACT

This thesis examines cost reporting at a Navy Branch Medical Clinic. Costs are traditionally reported under a partial cost reporting system. By applying basic principles of managerial accounting, a proposed full cost reporting system is created. Under the traditional system, one figure representing total consumption for each quarter is reported for each workcenter. Under the full costing model, costs are disaggregated into fixed and variable components. The thesis further explores the application of activity based cost reporting to create a second proposed costing system in which costs are reported as a function of the activities which drive them.

C.1

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I. INTRODUCTION

A. PURPOSE OF RESEARCH

The purpose of this research project is to analyze and organize costing information relating to the operation of a Navy Branch Medical Clinic, and to enhance its relevancy by building an improved costing model using basic principles of fixed and variable costing and activity based costing.

B. THE PROBLEM

Throughout the U.S. Navy, Branch Medical Clinic managers make critical decisions affecting support functions as well as health care delivery to eligible beneficiaries. These decisions are executed without all pertinent cost accounting data, or a complete understanding of resource consumption in the work center. With a health care delivery system having organizational characteristics of a world-wide health maintenance organization (HMO), it is possible that complex information management systems may tend to generate accurate but irrelevant costing information. One of the manager's responsibilities, however, is to concentrate his or her attention on the control of operating expenses. Consequently, the manager needs relevant decision support information for this purpose.

The challenge, then, is to enhance cost information currently available to health care managers resulting in an opportunity for the organization to improve decision making and more efficiently utilize scarce resources.

C. THE COSTING SYSTEM

Managerial accounting is defined as the reporting of information for use by individuals inside an organization. [Ref. 1:p. 3] Currently, many Navy Branch Medical

Clinic managers are solely dependent upon a resource allocation system based upon and concerned mostly with budget ceilings mandated by some higher authority. No organized costing methodology exists other than the antiquated OPTAR log system which is analogous to recording consumption in a checkbook. Accrual accounting is nonexistent at the Branch Medical Clinic (BMC) level, but does occur with some modification at the level of the larger Medical Treatment Facility (MTF) or Naval Hospital.

To be effective, the manager must have a feel for cost behavior, how costs perform over time, the relationship between fixed and variable costs as well as the impact of overhead. Ultimately the manager requires an accounting system that addresses all these needs. [Ref. 2:p. 45]

The focus of this study is on the operating expenses associated with health care delivery in the Navy today. Given the magnitude of the system, a subordinate organization within the larger system is used to assess cost behavior and managerial accounting in Navy Medicine. Financial records extracted from a sample Branch Medical Clinic describe a wide array of workcenter activity that represent the basic components of health care delivery.

D. SUMMARY

The current method of accounting for resource consumption at BMCs does not serve the Clinic manager; rather, the manager is harnessed by an inflexible system that ignores basic principles of managerial accounting. The central theme of this thesis is the manager's need for relevant cost information.

To develop recommendations for improving relevance, this study explores two perspectives on accountancy: full costing and activity based costing. The thesis is organized as follows. First, the resource allocation system is described to provide

background on how the current process of allocating budget ceilings for functional areas is created.

Next, the thesis progresses into a discussion of expense reporting based upon full costing as it relates to direct and indirect costs, controllable and non-controllable costs, and fixed and variable costs. A full cost reporting system is created using data collected from 1990. Then activity based accounting, is addressed. A model incorporating activity based costing techniques is formulated and demonstrated using historical data. Finally, relationships, inferences and implications are discussed prior to presenting recommendations for future research.

Only by demystifying cost information can managers be expected to interpret, plan and achieve organizational goals and objectives. Although it is not possible to make the current system "user friendly," it is possible through managerial accounting principles to enhance significance, and thus build greater confidence in decision making.

II. PROBLEM BACKGROUND

A. OVERVIEW

Before organizing costing information into a relevant structure for interpretation, an explanation of the funding process is necessary. This chapter will introduce the reader to background information essential to the discussion of cost information at Navy Branch Medical Clinics, and the budget principles that influence BMC managers' consumption of resources.

First, to serve as an introduction to the framework of the Navy budget process, a brief synopsis is presented to show how funding for BMCs is initiated under Congressional appropriations, and is finalized through spending limits, or budget ceilings. This is followed by an explanation of how the BMC manager receives quarterly funding targets, and what kind of authority the manager wields in the capacity of a financial manager.

Next, the impact of the present cost structure on the manager's ability to perform effectively and to successfully plan and direct work center operations is discussed. Several opinions are presented based upon a sample of informal interviews with BMC managers.

Finally, a suggested method for improving the available costing information through fixed and variable costing techniques and the potential applications of activity based costing (ABC) is introduced.

B. THE BUDGETARY CYCLE

Resource decisions to finance health care operations begin at the apex of the U.S. government when Congress appropriates funds based upon budget committee hearings. Briefly, the sequence of events occurs in the following description.

Appropriated funds are monies approved by Congress for specific purposes and are subdivided into activities, programs, and projects. Once the President signs the Congressional Appropriation Bill, the Department of Treasury and the Comptroller General (General Accounting Office) must jointly approve the release of funds before the Office of Management and Budget (OMB) can apportion funding.

Apportionment is defined as the limited authority to legally expend funds in a specified time period. OMB apportions funds to the Secretary of Defense for further distribution to the subordinate agencies (USAF, USN, USA). At this point, the Secretary of the Navy distributes funding limitations to the various organs of the Navy including the Bureau of Medicine and Surgery (BUMED). [Ref. 3:Chap 2, Part 5, P-3]

Quarterly, BUMED revises funding limitations for field activities. Limits are further classified based upon original Congressional specifications and distributed to managers. Figure 1 (next page) depicts a highly condensed outline of this complex process.

C. THE SYSTEM NOW

The BMC manager is dependent upon quarterly injections of funding. In the majority of branch clinic environments, funding levels are assigned by the hospital comptroller and are based upon consumption (in the form of budget requests) over prior years and available funding in the given year. Thus, the hospital comptroller monitors financial resources for the hospital Commanding Officer, and keeps a pulse on external hospital interests in the form of satellite clinics as well.

Funding levels can be increased or decreased contingent upon the needs of the hospital or the adjustments required to meet Congressional appropriations limitations. Funding is targeted for consumption in specific cost centers within the BMC (see Figure 2). Quarterly target figures are assigned to cost centers by an account code commonly referred to as a SAG/SFC code (Sub Activity Group/Sub-Functional Category).

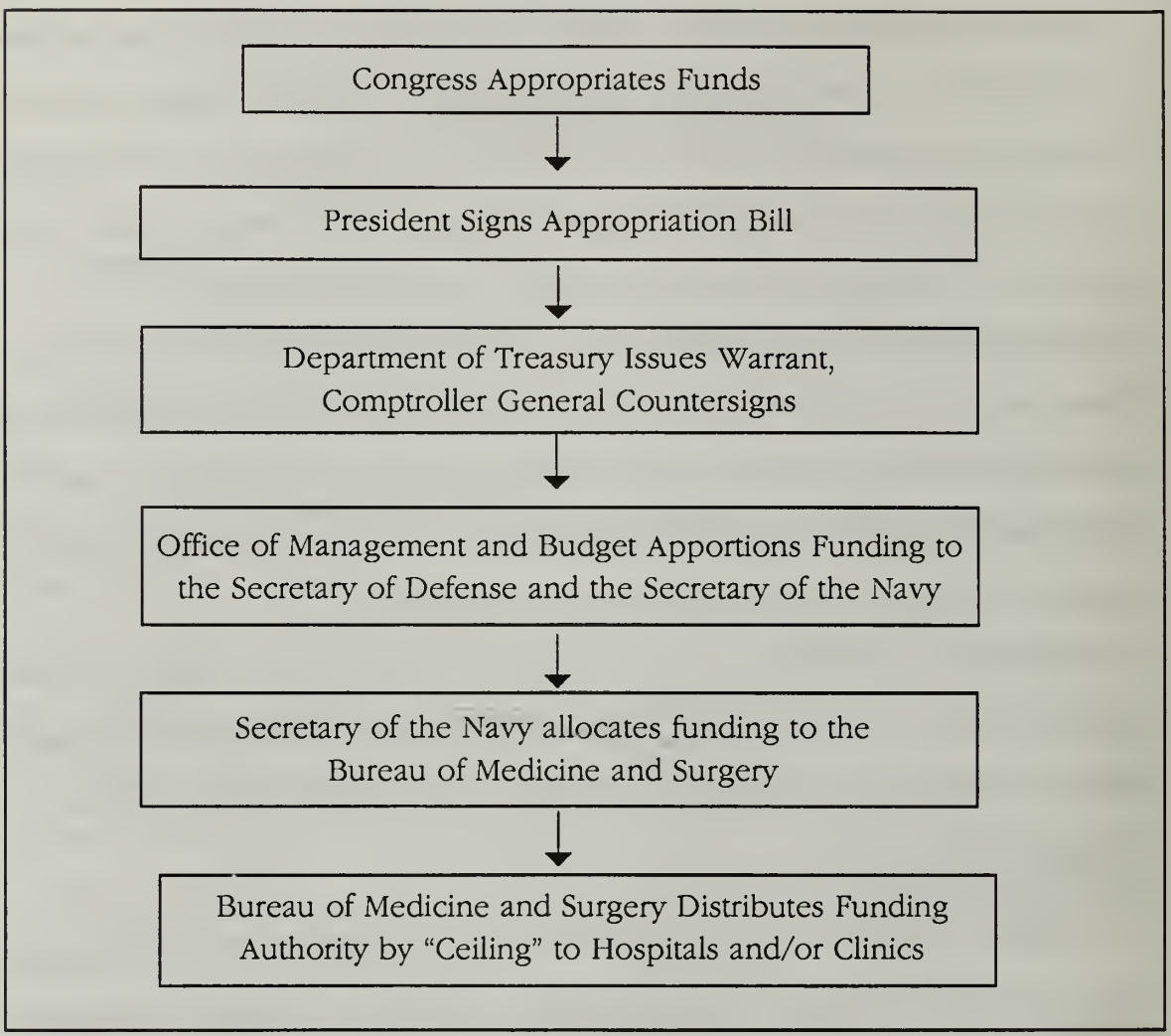

Figure 1. Navy Medical Funding Authority

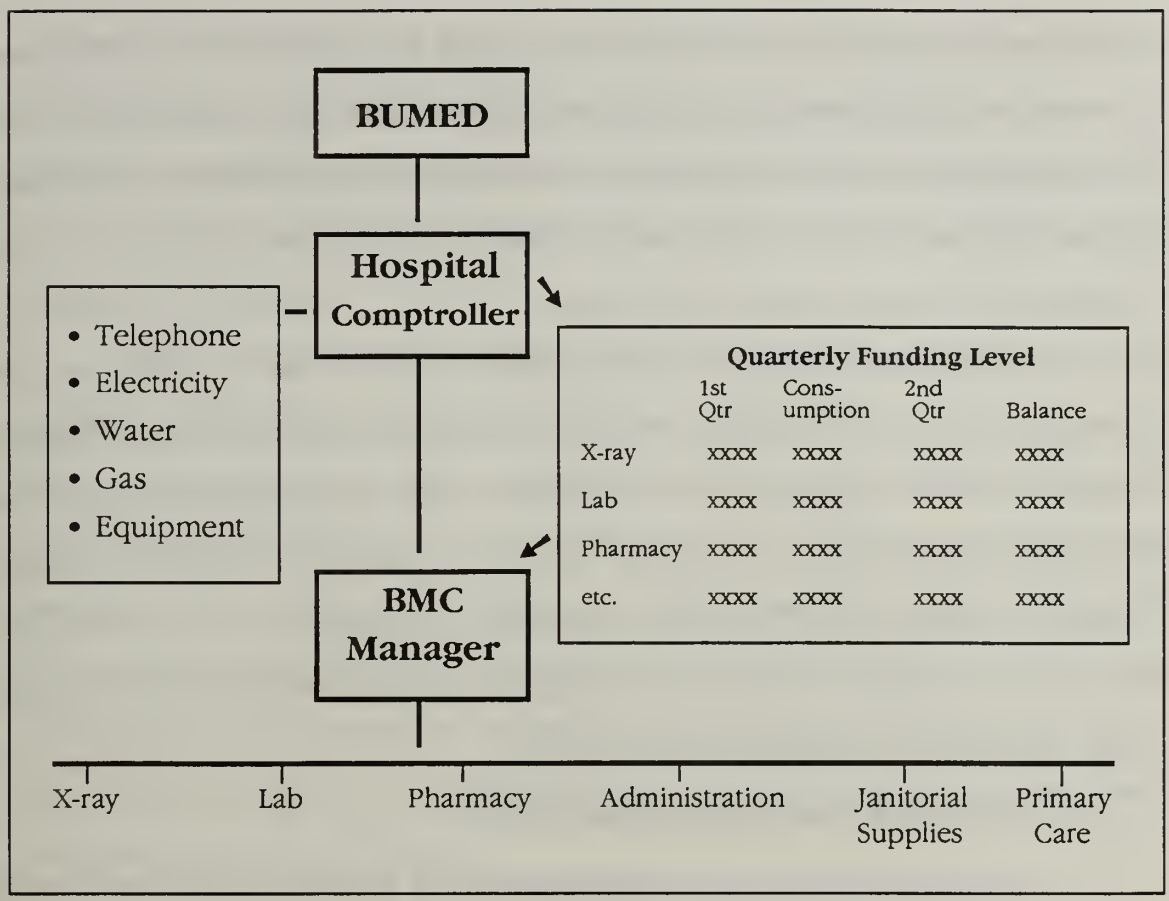

Figure 2. BMC Quarterly Cost Report

1. Quarterly Ceilings and Expenditure Control

Each quarter, the BMC manager receives funding and expensing information similar to a monthly bank statement. The quarterly report gives a breakdown of consumption in each workcenter controlled by the BMC manager. It also specifies the dollar ceiling for the previous quarter, the dollar sum or the consumable items purchased during the quarter, the balance remaining after purchases, the new quarter's funding level and concludes with a total balance forward.

The manager is responsible for monitoring consumption, and for ensuring that expenditures are kept within funding levels. Except in extraordinary circumstances,

operating expenses can never exceed target figures. No established cost management system or accounting structure is required other than to be able to reasonably account for consumption. Generally speaking, a "checkbook" system is used by the manager to match allotted funding targets with cumulative work center consumption and is commonly referred to as an "OPTAR Log."

The hospital comptroller closely monitors expenditures to ensure the clinic manager does not over-consume. When the manager commits funding to purchase a supply item, the comptroller records the transaction in the appropriate Job Order Number (JON) account. For example, laboratory workcenter funding is recorded under the M9YH SAG/SFC code, and consumption is noted in the N511T JON. [Ref. 4:Chap 2, Part 5, Sec. 103] The BMC manager and a designated representative are the only individuals authorized to commit funds.

2. Accounting Segregation of BMC Costs

Overhead expenses such as telecommunications, electricity, gas and water are not typically part of the BMC manager's direct responsibility. Although these costs are generated in the course of routine operations, the BMC manager neither sees them, nor is held directly accountable for their financial impact. Instead, these costs are aggregated under general utilities expense accounts and managed by the hospital civil engineer, or in the case of telecommunications, the hospital telecommunications officer.

In contrast with overhead expenses, routine material items in the form of consumable supplies are directly controlled by the BMC manager. Pharmaceutical supplies, bandages, and laboratory reagents are examples of routine material costs associated with delivering health care.

To sum up the case of overhead expenses and consumable supplies in the case of a BMC X-ray division, consumable supplies consist of those inputs into the mechanical or chemical processes that give rise to a completed X-ray film series.

However, the electricity that powers the equipment is reported separately under a different JON and is the responsibility of the MTF civil engineer. Hence, this cost is assigned to a different work center from the cognizant work center. The BMC manager is not informed, has little or no incentive to find out and, therefore, effective decision making cannot occur.

Direct labor is another example where relevant costs are redistributed. Labor comes under the category of either civil service or military. Because the BMC manager has no organizational authority over payroll functions, and is not directed by senior management to be alert to the impact of labor costs, he is often unaware of the expense associated with labor inputs. Where the military member is paid directly from Congressional appropriations to the Department of the Navy, the civil servant is paid from funding which is controlled by the hospital comptroller. Once again, the manager has no little or no incentive to monitor labor costs or to be aware of cost relationships between labor and productivity.

D. PROBLEMS WITH THE EXISTING SYSTEM

A manager's job consists of planning, organizing, directing and coordinating. Whenever supervisors or managers are not actively planning, organizing, directing and coordinating, they are not really managing. [Ref. 5:p. 202] From an informal phone survey of four representative BMCs, data was collected regarding the more significant problems managers experienced that were a direct reflection of the adequacy of the existing costing system. [Ref.6]

All of those managers interviewed stated that they operated from the OPTAR log, or partial cost reporting system for resource consumption.

Five problem areas with the existing system were repeatedly mentioned in the phone survey. These are discussed as follows:

1. Reactive Versus Proactive

The budgetary cycle conditions managers to "react" to budget ceilings rather than to "respond" rationally to salient costing information. It provides no incentive or reward for managers to interpret, or look beyond the funding limits imposed upon their areas of responsibility. Since the information is of marginal value, the manager is unable to draw meaningful conclusions beyond the volume of current funds consumed relative to the budget ceiling. One manager referred to his cost management system as "meaningless."

2. Historical Based Budgeting

Budget ceilings tell the manager very little other than that he has more or less funding than the previous year to allocate among work centers. Managers become overly dependent upon historical work center budgets to justify future requirements rather than planning future needs by relying upon the demands of the patient population base. For instance, a clinic manager who experienced lower volume in fiscal year 1990, and was funded in fiscal year 1991 based upon the 1990 level of consumption, was penalized in 1991 when Desert Storm assets returned from the Persian Gulf and service demand grew to levels greater than those recorded in 1990. Accordingly, historical based budgeting does not permit the manager to execute viable strategies.

3. Barriers to Costing Information

Information exchange cannot focus on pertinent cost relationships since the BMC manager does not receive information about all of the pertinent relationships. The manager cannot reasonably address overhead in his clinic because it is only meaningful to the civil engineer who receives the raw costing data. This has a subtle, yet significant impact upon the manager's ability to influence the cost of operations.

4. Centralized Costing Data

Rather than providing managers with a broad spectrum of costing information relative to their specific responsibility areas, cost data is recorded and collated in the cognizant hospital accounting department where information is aggregated by account category with other work centers for reporting to higher authority. Most managers interviewed felt powerless, believed the system was inflexible and were convinced they were managing in a vacuum.

E. IMPROVING THE PROCESS

Many of the problems cited in the informal phone survey can be attributed to the lack of a credible costing system. Managers were frustrated, and had no confidence in the system. They were being held accountable for resource consumption, but were not given the authority or the tools necessary to adequately interpret signals, communicate management intentions and execute strategic planning. It is the intent of this thesis to improve the costing information by upgrading the costing methodology.

One way to improve the cost reporting system is to recognize that the full cost of a product or service includes both direct and indirect costs. For the purposes of this study, direct costs are defined as: any cost which is identified with a specific product, department or service. Whereas indirect costs are defined as: any cost not directly identified with a single product, department, or service.

A second way to improve the costing process is by using standard techniques in managerial accounting to evaluate expenses. Defining which costs are fixed and which are variable is necessary to building an improved system. For the purposes of this study, fixed, variable and overhead costs are defined as follows:

1. Variable costs

These costs increase or decrease in proportion to the volume of activity. For example, in the laboratory, the total cost of blood agar medium fluctuates in proportion to the volume of throat cultures performed. As the flu season progresses, blood agar medium is consumed as a function of the number of throat cultures collected, and the endemic duration of the virus. [Ref. 2:p. 46,47] For the X-ray work center, processing chemicals and X-ray film vary with the volume of patients requiring radiography. Hence, the costs are variable.

2. Fixed Costs

Those costs which stay relatively constant in total are fixed in nature. When fixed costs become dynamic, and fluctuate outside a relevant range, they become variable. [Ref. 7:p. 35] Salaries are a good example of a fixed cost since they remain relatively constant regardless of the variation in patient volume.

3. Overhead

Direct costs are those individual costs which can be traced to a final cost object. A cost that is not directly traceable is classified as an indirect cost or overhead cost.

Indirect costs are shared costs that may be further distributed or allocated to cost centers. Use of appropriate cost allocation techniques may allow the manager to closely approximate total costs and further clarifies existing cost relationships. For instance, the cost of janitorial service is a shared cost in most facilities. As an indirect cost, it can be decomposed and distributed among relevant work centers.

F. ACTIVITY BASED COSTING

An additional set of ideas that may lead to improved cost information is activity based costing. Activity based costing (ABC) assigns costs to products based on the actual consumption of organizational resources. Activity-based information concentrates

on activities that consume resources and return some value to an entity. People consuming resources in the performance of work ultimately cause costs and produce the value customers pay for [Ref. 8:p. 65].

ABC is a response to the belief that contemporary cost accounting and management control systems are no longer providing accurate signals about the efficiency of internally managed transactions. When senior management no longer receives accurate information about the efficiency and effectiveness of internal operations, the organization becomes vulnerable [Ref. 9:p. 205].

Overhead costs are traditionally accumulated in pools and allocated to a cost object using some allocation base such as direct labor dollars, hours, or machine hours. In this way, total overhead costs are segregated and applied to work centers contingent upon a common allocation base. This allocation method assigns overhead fairly, if and only if, the base used is highly correlated to the use of the overhead [Ref. 10:p. 15].

A frequent claim of ABC experts is that cost distortion can occur in traditional accounting systems when costs are allocated to products using direct labor hours, resulting in low volume products tending to be under-costed and high volume products that are over-costed.

The additional costs of specialized activities are often not placed on the products that generate the added activities. Generally they are allocated to the mature, high volume, stable products which become more costly as the organization continues to diversify and deliver specialized products. The mature products subsidize the firm's product proliferation activities through the aggregation and averaging effects of a direct labor cost allocation system [Ref. 9:p. 190].

A classic example of cost distortion is described by Robin Cooper and Robert Kaplan [Ref. 11:p. 98] in their lavender pen and blue pen manufacturing model. Pen

production plant II (blue, black, red and lavender pens) reports production costs for the high volume blue pen trade that vastly exceed the cost for the same product built in Plant I (blue pens only). This is due to the cross subsidization of costs Plant II must pay for in diversification under traditional costing. Plant I does not have to allocate the costs of less successful products, (black, red, lavender), resulting in cost distortion, because it focuses on competing under one cost objective.

By managing the processes that give rise to costs, ABC claims to solve cost distortion. ABC systems have been introduced into a variety of manufacturing and industrial environments. ABC has had limited application in health care settings, the most noteworthy of which is the implementation of a pilot project for the British National Health Service. [Ref. 12:p. 26]

G. SUMMARY

This chapter introduced a brief explanation of the funding process and how it links the work center manager to the larger budgetary cycle. The manager's ability to plan, coordinate, organize and direct is impeded due to barriers to costing information, reactive versus proactive, centralized costing data and historical based budgeting. Improving the quality of information used by the manager may be possible using fixed and variable costing techniques or activity based costing. In the next chapter, application of fixed and variable costing and activity based costing are applied to the X-ray work center data from fiscal year 1990.

III. THE FULL COSTING MODEL

A. OVERVIEW

This chapter analyzes the cost behavior of a BMC with the intent of designing a cost system that is sensitive to the needs of the branch clinic manager. Rather than examining the health care delivery system of the clinic as a whole, a more manageable study of a single X-ray workcenter is conducted.

Developing an improved model requires analyzing and organizing all the components of a cost management system to include such elements as labor, materials, overhead and both direct and indirect costs. By reassembling these components into a structure that reports full costs instead of partial costs, the manager's understanding of BMC operations is enhanced. Armed with costing information the manager's capacity is fortified to influence operations and better manage resources. No longer are decisions executed based upon a partial cost information system.

This chapter begins by comparing the present cost information system with the proposed system. The next section is devoted to describing the behavior of chemicals, materials, and film costs relative to exposure needs. Then a discussion of direct and indirect labor is presented as it pertains to civilian and active duty manpower. Overhead is then discussed in terms of two allocation bases. First, energy costs are allocated through consumption in watts, and second, sqare footage is used for allocating other indirect costs. The final section defines costs and other considerations which were not significant enough to warrant inclusion in this study. At the conclusion of this chapter, the reader will have a better measure of the cost of operating a BMC X-ray division using full costing.

B. PRESENT MODEL VERSUS PROPOSED MODEL

In comparing the present cost reporting system to a full costing model, Table 1 portrays the advantages and disadvantages of the present and proposed systems. By examining Table 1, one observes that the present system gives a measure of partial cost. [Ref.13:p.1] The X-ray department consumed direct materials (X-ray film and chemicals) totaling $2,896 for the first quarter. As described, out of a quarterly funding level of $6,000, by the end of the quarter $3,109 remained unobligated. The manager ideally requires total cost. Where the present system generates direct and controllable costs, the proposed system, or full costing model, includes direct and indirect costs as well as controllable and non-controllable expenses.

Under the present partial costing system, the manager must evaluate performance from only one figure which represents a measure of total expense. The manager is denied the opportunity of knowing what cost type was consumed and to what level of detail.

In the proposed system, the $2,986 figure is disaggregated into detailed cost measures. In disaggregation, the manager is rewarded with an increased level of detail regarding cost behavior. For example, direct materials is further subdivided into a fixed and variable component identified by fixed chemicals and variable film costs. Non-controllable costs that are further disaggregated, such as heating and electricity, exhibit variable cost behavior.

The present system assumes that costs are accumulated, segregated by department and reported quarterly. The proposed system does more. It tells the manager what costs are fixed and what costs are variable. It not only reveals cost behavior, but also informs the manager of those short-run, non-controllable, yet pertinent costs. Where partial costing presumes that only direct costs are relevant to a manager, full costing dis-assembles expenses into cost relationships that may be fixed or variable, direct or indirect, controllable or non-controllable.

COST REPORTING SYSTEM

Table 1

THE PRESENT SYSTEM

FY 1990 OPTAR BY ACTUAL OBLIGATION

Naval Station Branch Medical Clinic

SAG/ DEPARTMENT	OPTAR 1st QUARTER	ACTUAL OBLIGATION	UNOBLIGATED BALANCE
M9YJ X-ray	**$ 6,000**	**$ 2,896**	**$3,109**
M9YG Pharmacy	$ 16,000	$15,722	$ 278
M9YH Laboratory	$ 7,400	$ 6,177	$1,123
M9YR Pri Care	$ 5,900	$ 5,715	$ 185

THE PROPOSED SYSTEM

X-Ray Department, 1st Quarter (1990)

Variable Costs	
Direct Materials (X-ray film)	$ 2,629
Electricity	$ 908
Fixed Costs	
Chemicals	$ 267
Heating	$ 261
Direct Labor	$12,705
Indirect Labor	$ 1,017
	$17,787

C. COST BEHAVIOR

Now that an explanation of partial cost reporting and full cost reporting has been presented, a more detailed discussion of fixed and variable costs can be conducted. This section examines the costs associated with X-ray chemicals, X-ray film, labor and overhead. Each category is identified as either fixed or variable, and as either direct or indirect. Costs are discussed based upon actual expenses recorded during BMC operations in fiscal year 1990. Furthermore, each subsection presents an associated cost from first quarter consumption in the BMC department.

The completed output of the X-ray Department, typically an X-ray film product, is made up of a variety of inputs. These basic inputs to the final X-ray film product include: materials (in the form of X-ray film and chemicals), labor (both direct and indirect), and general overhead (consisting of heating and electricity). Each of these costs are discussed below.

1. X-ray Chemical Costs

Chemicals refer specifically to developer and fixer. The general price of chemicals fluctuates very little and was constant during the course of this study. Consumption of chemicals is relatively constant as well, such that twenty gallons of developer (approximately $61) and twenty gallons of fixer (approximately $28) are routinely consumed each month regardless of patient volume. Therefore, in a given quarter, $267 is expended in the consumption of chemicals for processing X-ray film.[1] The consumption is constant because chemicals are changed frequently as time passes, not in response to the number of exams. Note that this procedure is specific to the X-ray

[1] (28 + 61) 3 = $267

division examined. Larger departments may require more frequent replenishment, or may have a different policy altogether.

Thus, chemicals consumed in X-ray department operations are a fixed cost. Since chemicals are linked directly to the production of a completed X-ray film, they are direct costs. In the first quarter of fiscal year 1990, chemicals cost the BMC manager $267.

2. X-ray Film Costs

X-ray film is closely associated with the type of film series ordered by the physician, and fluctuates with demand. X-ray film cost is highly variable and is not only a function of volume but of the *type* of film series performed. For instance, one X-ray film size 35x43 cm can be used during a routine physical examination (see Appendix A, chest PA). However, to perform asbestos screening on the chest, two films of the same size must be exposed.

The *size* of film also influences the cost of the film. An ankle series is more expensive than a knee series because the size of film is larger. Thus, sizes of film, and type of film series ordered drive the cost of X-ray film consumption for a particular individual X-ray exam, while patient volume drives the number of exams.

A breakdown of the size and cost of film for eleven of the most common examinations, also referred to as series, is described in Appendix A.[2] The cost of X-ray film

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[2]Department operations are not restricted to these specific exposures. For instance, a physician could order a skull series if a particular patient has severe sinusitis and the physician considers the examination clinically necessary. The skull series is an example of a small number of rare situations in which the physician may order a unique film exposure taken. A skull series, however, occurs so infrequently that in generating a representative model, "out of the ordinary" series such as this are not included in the analysis.

consumed for each series is easily calculated in a quarterly period. The computed cost for each of eleven possible X-ray series (Appendix A) is multiplied by the volume of each series performed in a quarter (Appendix B) resulting in a measure of the quarterly film cost as a function of volume.

Thus, X-ray film is a variable cost that fluctuates as a function of volume. It is also a direct cost of producing a completed X-ray film product. In fiscal year 1990, the cost in film for the first quarter amounted to $2,629.32 and was a function of 1,262 patient visits (Appendix C).

3. Labor Costs

a. Direct Labor—Military

All patient contact is performed by two trained military technicians. For measurement purposes, these two individuals are defined as active duty second class petty officers (E-5) with one dependent wife and over six years military service (see Appendix D). Based upon this normative data, their hourly wage rate is calculated to be approximately $9.20 per hour or $.153 per minute and includes compensation for living in non-military housing.

Military labor is a direct labor cost identifiable with a specific service related product, X-ray exams. Since military personnel are salaried, and salaries are constant, military labor is a fixed cost. Military labor is combined with civil service labor to amount to $12,705 during the first quarter of fiscal year 1990. Of the $12,705, roughly two-thirds, or $8,820 was the direct cost of military labor.

b. Direct Labor—Civil Service

Routine administrative tasks such as filing and answering the phone is relegated to one Civil Service Administration clerk classified as General Service Rate 4 step 3. Based upon standard wage rates for 1990, this individual earns approximately

$10.79 per hour or $.18 per minute. Civil Service personnel are not authorized compensation for housing as are military personnel.

In this particular situation, civil service labor is a direct labor cost associated with a single service related product, X-ray exams. Civil service personnel are also salaried and are therefore a fixed cost of operations. Of the $12,705 in direct labor costs during the first quarter fiscal year 1990, $3,885 amounted to the direct cost of civil service labor.

c. Indirect Labor

Indirect labor is confined to two janitors whose salaries are derived from wage rate schedules generated from the Department of Defense, Office of Personnel Management (OPM). Under the Civil Service System, labor intensive positions require the presence of a supervisor "leader." Consequently, the model construct reflects two janitors in Wage Grade Rating 4, step 4 and Wage Grade Rating 3, step 4 positions respectively (see Appendix D). The hourly wage of $9.69 (leader position) and $8.77 (laborer position) is based upon OPM data which takes into consideration the community standard. The allocation of indirect labor cost among the different workcenters is further discussed under General Overhead.

Janitorial labor is an indirect cost since it cannot be directly identified with a specific product or service. Since janitors are categorized as salaried civil service labor, they are a fixed cost. For the first quarter of fiscal year 1990, indirect labor amounted to a cost of $6,645.

Administrative support personnel, purchasing clerks, and supply clerks are also indirect labor inputs, but are difficult to quantify and of negligible impact. Except where material procurement is influenced, they will not be included in this study.

4. General Overhead

Overhead consists of indirect inputs into the X-ray film production process. The volume of each input consumed is reported in terms of total cost to the facility, and not by distinguishable work center environments.

Utilities consumed in the department include electricity, water, telecommunications, and gas (heating and air conditioning). Water is a minor cost driver that has no influence on activity, and telecommunications consumption is not measured.[3] As a result, in constructing the costing model of the X-ray department, overhead is limited to indirect labor, electricity, and gas. Usage is reported in total consumption by the facility, hence, shared costs are broken out to enhance relevancy.

Determining the cost of each of these categories attributable to X-ray department operations depends upon an understanding of how indirect labor, gas and heating expenses are allocated throughout the facility. An examination of allocable costs is discussed below.

a. Allocation of Indirect Labor

The BMC is segregated into several cost objectives or work center functions which typically follow the flow of an organizational chart. Separating the cost of indirect labor for the X-ray department requires an understanding of its contribution to the facility as a whole.

For indirect labor in the form of janitorial services, usage is a function of square feet of space. For example, the janitor in each work center empties the trash,

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[3]Telecommunications is not measurable because the phone company is unable to itemize charges. The monthly billing only lists the time and charge for calls made to the main clinic number. Funding was not available during planning and installation to purchase the requisite software for monitoring usage by department or office extension.

cleans the toilet, and strips and waxes the floor. He performs identically the same sanitation management procedures and obeys the same infection control standards regardless of the department he is cleaning. If the department is larger in comparison to other departments, generally it has more trash cans to empty, more floor space to maintain and more high dusting to be performed.

Consequently, square feet of space is a reasonable common denominator in the consumption of janitorial labor, and serves as an appropriate vehicle for allocating cost. Using square feet of space as an allocation base aids in assigning indirect costs to distinctly separate cost objectives or work center functions (see Appendix E). Since Janitorial services rarely fluctuate with a change in patient volume, it is not only an indirect cost, but a fixed cost as well. Although square feet of space is not the only cost driver that can be used, it approximates a reasonably accurate measure of indirect costs associated with janitorial labor in the X-ray department.

The X-ray department consumes approximately 15.3% of the overall facilities resources based upon the distribution of space (see Appendix E). Additionally, this value represents the fair distribution of common space (corridors, patient waiting areas) into equal portions for each department to participate in shared costs. Thus, the cost of indirect labor in the form of janitorial services allocated to the X-ray department amounts to 15.3% of the janitorial wage (Appendix D) or $1,017 in the first quarter of fiscal year 1990.

b. Allocation of Gas & Heating Expense

Similar to indirect labor, gas and heating consumption in the BMC facility is proportional to the total square feet of space. The volume of space heated is a function of the energy consumed to heat that particular work center. Hence, the size of the work center drives gas and heating usage. The larger the work center area,

logically, the more energy required to keep the space heated. Consequently, square feet is a practical measure for the consumption of gas and heating, and serves as an appropriate vehicle for allocating cost. Furthermore, gas and heating is a fixed cost patient volume has minimal impact on usage.[4]

Using the 15.3% allocation rate for the X-ray department based upon square feet of space, heating and gas consumption in the first quarter of 1990 amounts to $261.

c. Allocation of Electricity

Electrical power usage is less uniform than indirect labor. For example, a duplication machine is used infrequently relative to the constant power drain of overhead lights. Attempting to measure the power usage of a duplication machine is very challenging, but measuring the energy consumed by overhead lights in an eight hour work day is relatively elementary.

Additionally, the laboratory work center has a myriad of electronic devices to perform analytic chemistries of urine and blood, or to spin down samples in a centrifuge. Each device drains electricity based upon demand. In contrast to the heavy demand of the laboratory, the administration work center operates two word processors, a microcomputer and shuffles paper.

Computing the number of light sources, electrical outlets and electrical devices is not enough to accurately quantify usage. Determining consumption accurately requires sophisticated monitoring devices measuring usage of individual sources during peak and slack periods. This is impractical.

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[4] Cubic feet is a more accurate measurement for assessing ventilation capacity. For this study, a constant eight foot ceiling is assumed throughout the facility, allowing square footage as a reasonable indicator of space utilization.

Is an accurate calculation really necessary? For reasonable cost allocation, it is not. An approximation is easier to apply, far more practical and gives satisfactory results for management purposes.[5] The best approximation is created by computing the "total potential" in watts for each cost objective. The total sum of electrical potential in the facility serves as an allocation base, or common denominator, that is traceable to each unique cost objective. Since each work center behaves differently, a measure of potential electrical consumption is the best available method for determining activity.

In arriving at a value for power usage in the X-ray department, the "potential consumption" in watts for each department is summarized, and the electrical consumption for the X-ray department approximated relative to total potential consumption (Appendix G).

Thus, electrical energy cost can fluctuate with patient volume and is considered a variable cost. Consumption in the X-ray department amounts to 2448 Watts out of a total facility potential of 30,668 Watts. Thus, using an allocation rate of 7.98%, the first quarter fiscal year 1990 cost for electricity in the X-ray department amounts to $908.

5. Other Considerations

Routine supplies which include pencils, file folders and X-ray film jackets are administrative costs that range from $40 to $60 in monthly consumption. For the purposes of this study, their impact is insignificant.

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[5] Conversation with Craig Jensen, electrical engineer, NPS Monterey, of 19AUG92. The Uniform Building Code requires a similar computation in calculating total electrical capacity during the design process in any building construction.

Indirect materials in the form of lubricating fluid, cleaning fluid, and rinse solutions are also of minor consequence and difficult to quantify or estimate. They are not measured in this study.

Routine maintenance and replacement of X-ray machines, film processors, typewriters and minor supplies are also awkward to measure due to extreme variation in useful life and cost of replacement. For example, chemical developers are highly corrosive and rapidly degrade the normal life of most film processors. In constructing the BMC model, these constraints are not considered. Projected maintenance and replacement of equipment and minor supplies is held constant. Depreciation of major equipment and buildings is a new concept that is rarely used in Federal accounting systems. Consequently, depreciation will not be examined.

The loss of damaged or exposed film, the expiration of potency for chemicals, are all incalculable costs for the purposes of this model.

D. SUMMARY

Under the present BMC system, a partial measure of the cost incurred of operating the X-ray department is provided each quarter reflecting only direct costs. This chapter discussed step by step the development of a cost information system based upon full costs. The proposed system provides total costs, reflecting both direct and indirect costs, and identifies those costs as fixed and variable. The proposed system is an improvement over the present partial cost system because it gives the manager more pertinent information regarding operations, and it increases the level of detail through disaggregation of costs.

The chapter described the cost behavior of specific inputs to the X-ray workcenter. Chemicals were identified as a fixed cost and X-ray film as a variable cost. This was followed by a discussion of direct and indirect labor relative to active duty and civil

service labor inputs. Overhead was then examined based on the appropriateness of different allocation techniques. The chapter closed with a brief review of considerations made in creating the full costing model.

Ultimately, the full costing system provides the manager with a greater understanding of the cost of operating an X-ray department or BMC. With increased confidence in the cost information system, the manager should be able to improve decision making.

In the next chapter, the present system is compared to the proposed activity based system. It discusses activity behavior, and the dissection of the BMC X-ray division into distinct activity products. Using activity analysis, activity mapping and a bill of activities, a cost management system is created based upon "what an enterprise does," and "the way time is spent."

IV. THE ACTIVITY BASED MODEL

A. OVERVIEW

This chapter extends the examination and development of cost reporting systems by presenting a different costing model based upon activity based costing. Measuring the "cost of activities" associated with delivering health care gives the BMC manager yet another perspective on operating costs. A costing system derived from principles of activity based costing purportedly limits distortionary effects created by inappropriate allocation of the cost of indirect activities which contribute to overall cost.

This chapter begins with an introduction to critical terms associated with activity accounting. The next section is devoted to comparing the present partial cost system to activity based costing. Although there are a variety of methodologies for implementing an activity based costing system, this study will use the approach developed by James Brimson.[6]

The Brimson method is the most comprehensive formula for focusing specifically on how to implement an activity based cost reporting system. Basic principles inherent to the Brimson approach, and a detailed discussion of the step by step sequence of events to developing the Brimson model are presented. Activities are examined in four successive phases, beginning with activity analysis, followed by activity mapping, the bill of activities and concluding with activity cost.

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[6]See Activity Based Accounting, An Activity Based Costing Approach, by James A. Brimson, 1991.

Activities are divided into two categories based upon contributing directly to some output (primary activity) or upon "supporting" a primary activity (secondary activity). Primary and secondary activities are then combined with overhead to arrive at a final measure of cost per activity. Upon completion of this chapter, the manager will have a firmer grasp of the cost of operating an X-ray department using an activity based cost reporting system.

B. CRITICAL TERMS

Before pursuing an exploration of activity cost management, an introduction to the critical terminology in an activity accountant's vocabulary is briefly presented.

- Activity: A combination of people, technology, raw materials, methods, and environment that produces a given product or service. It describes what an enterprise does; the way time is spent and the outputs of a process. [Ref. 14:p. 46]

- Cost Driver: A factor whose occurrence causes a cost and has a causal effect on the level of activity. [Ref. 14:p. 203-209]

- Cost Objective: A department, activity, service or end product for which a cost measurement is desired (e.g. a cost center, cost of placing an order, cost of janitorial service).

- Tracing: Linking activity consumption to a cost objective. A traceable cost is a cost that can be assigned to a specific product output.

- Allocation Base: Systematic means of assigning cost to a cost objective, a common denominator (e.g. direct labor hours for janitors). [Ref. 15:p.478]

- Primary Activity: Outputs used externally to a work center function (e.g. taking an X-ray of a patient). [Ref.14:p.96]

- Secondary Activity: Outputs used internally to support primary activities (e.g. training a subordinate in a new procedure, answering the phone). [Ref.14:p.96]

- Function: An aggregation of activities related by a common purpose (e.g. a department, division, or workcenter).

- Business Process: A network of interdependent activities linked by inputs to outputs.

- Organizational Analysis: A process of gathering information on an organizational activity through examining job classifications, data processing records, key personnel, observing activities, consulting experts, logbooks, and checklists.

- Business Process Analysis: Traces inputs to outputs from one activity to another. A structured sequence of activities.

- Activity Measure: An input, output or physical attribute in an activity. A factor by which costs in a process vary directly, a dependent variable.

C. PRESENT MODEL VERSUS PROPOSED MODEL

As was previously performed with the full costing model, the present partial cost reporting system is compared to the activity based cost model as illustrated in Table 2. With a quarterly funding level of $6,000, the X-ray department consumed $2,846 and experienced a surplus at the end of the quarter amounting to $3,109. This represents the complete cost report generated under partial costing.

In contrast, the proposed model dis-assembles the cost of operating the X-ray department into the expense of performing specific activities. Activities can involve direct patient care in which case they are classified as primary activities, or they can support direct patient care and are termed secondary activities. Furthermore, overhead that may include controllable or non-controllable costs is also considered.

Note from Table 2 the cost relationships that are illustrated between primary activities in the proposed system. Specific costs are provided for the product of each category of X-ray department health care service. The BMC manager now possesses salient information on the cost of delivering an identifiable health care product. The proposed system under activity based costing emphasizes the cost of all significant activities involved in performing health care delivery.

COST REPORTING SYSTEM

Table 2

THE PRESENT SYSTEM

FY 1990 OPTAR BY ACTUAL OBLIGATION

Naval Station Branch Medical Clinic

SAG/ DEPARTMENT	OPTAR 1st QUARTER	ACTUAL OBLIGATION	UNOBLIGATED BALANCE
M9YJ X-ray	**$ 6,000**	**$ 2,896**	**$3,109**
M9YG Pharmacy	$ 16,000	$15,722	$ 278
M9YH Laboratory	$ 7,400	$ 6,177	$1,123
M9YR Pri Care	$ 5,900	$ 5,715	$ 185

THE PROPOSED SYSTEM

X-Ray Department, 1st Quarter (1990)

Primary Activities

Knee Series	$ 285
Hand Series	$ 219
Cervical Spine	$ 231
Shoulder Series	$ 182
Elbow Series	$ 89
Chest (PA)	$ 726
Chest Acute	$ 528
Chest Asb.	$ 2,294
Ankle Series	$ 296
Acute Abdomen	$ 90
Abdomen	$ 67
TOTAL	**$ 5,010**

Secondary Activities

Training	$ 419
Answering Phone	$ 927
Verify & File Films	$ 533
Other Direct Labor	$ 8,645
TOTAL	**$10,988**

Overhead

Janitorial	$ 1,017
Heating	$ 261
Electricity	$ 908
TOTAL	**$ 2,186**

TOTAL COST OF X-RAY ACTIVITY = $17,721

Under the current partial costing system, the manager must evaluate performance with only one piece of information. The proposed system reports controllable and non-controllable expenses as well as direct and indirect costs provided they are relevant to the cost of activities performed. The cost of the X-ray department is disaggregated into particular tasks that are highly detailed cost components of an overall activity. Activity based costing surpasses the detail advanced in full costing by focusing on fundamental cost ingredients.

D. EVALUATING ACTIVITIES

An activity is a process or workload pattern that can be quantified. Once the activity is quantified, a cost can be attached allowing it to be measured and managed. A variety of techniques to implementing an activity cost management system exist, however the Brimson model appears to be the most detailed. Brimson defines an activity as:

> a combination of people, technology, raw material, methods and environment that produces a given product or service. It describes *what* an enterprise does: the way time is spent and the outputs of the process. [Ref. 14:p. 203]

Identifying the activities that are instrumental in performing a health care function provides a foundation for understanding cost. Activities provide the basic tools to trace costs to cost objectives. Brimson advocates a seven step approach to designing an activity cost management system in a complex organization. In applying Brimson's methods to the smaller X-ray department model, Brimson's seven steps were combined into four more general steps to arrive at a final activity cost.[7] Performing

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[7]Activity Analysis, Life Cycle Classification, Tracing Resources, Activity Measure, Performance Measures, Business Process Costs, Activity Product Costs

activity analysis, creating an activity map and generating a bill of activities is discussed below in order of occurrence.

1. Activity Analysis

Activity analysis is used to decompose complex organizations into elemental activities and manageable outputs. Activity analysis identifies significant activities of an enterprise to establish a clear and concise language for describing operations, cost and performance.

Performing activity analysis consists of identifying activities, defining each activity, assigning a time value measurement for the activity and classifying it as either primary or secondary. Brimson describes three approaches to performing activity analysis: business process analysis, functional analysis and organizational analysis (see Figure 3).

He recommends a comprehensive organizational analysis prior to deciding upon a business process or functional approach. This study concentrates on the performance of a single X-ray work center in relation to six other functional areas (Laboratory, Pharmacy, Primary Care, Physical Exams, Medical Records, Supply and Administration), and uses business process analysis rather than the functional analysis methodology. [Ref. 14:p. 97]

The advantage of the business process approach is in graphically connecting all activity inputs and outputs between departments. However, the analyst must be adept at including hidden processes that may escape his notice such as secretarial support. [Ref. 14:p. 91]

Executing activity analysis requires adhering to the following guidelines. [Ref. 14:p. 81]

- Activity definitions must be logically consistent with the organizational objectives. They must be an accurate representation of the work center to be useful tools for activity cost management.

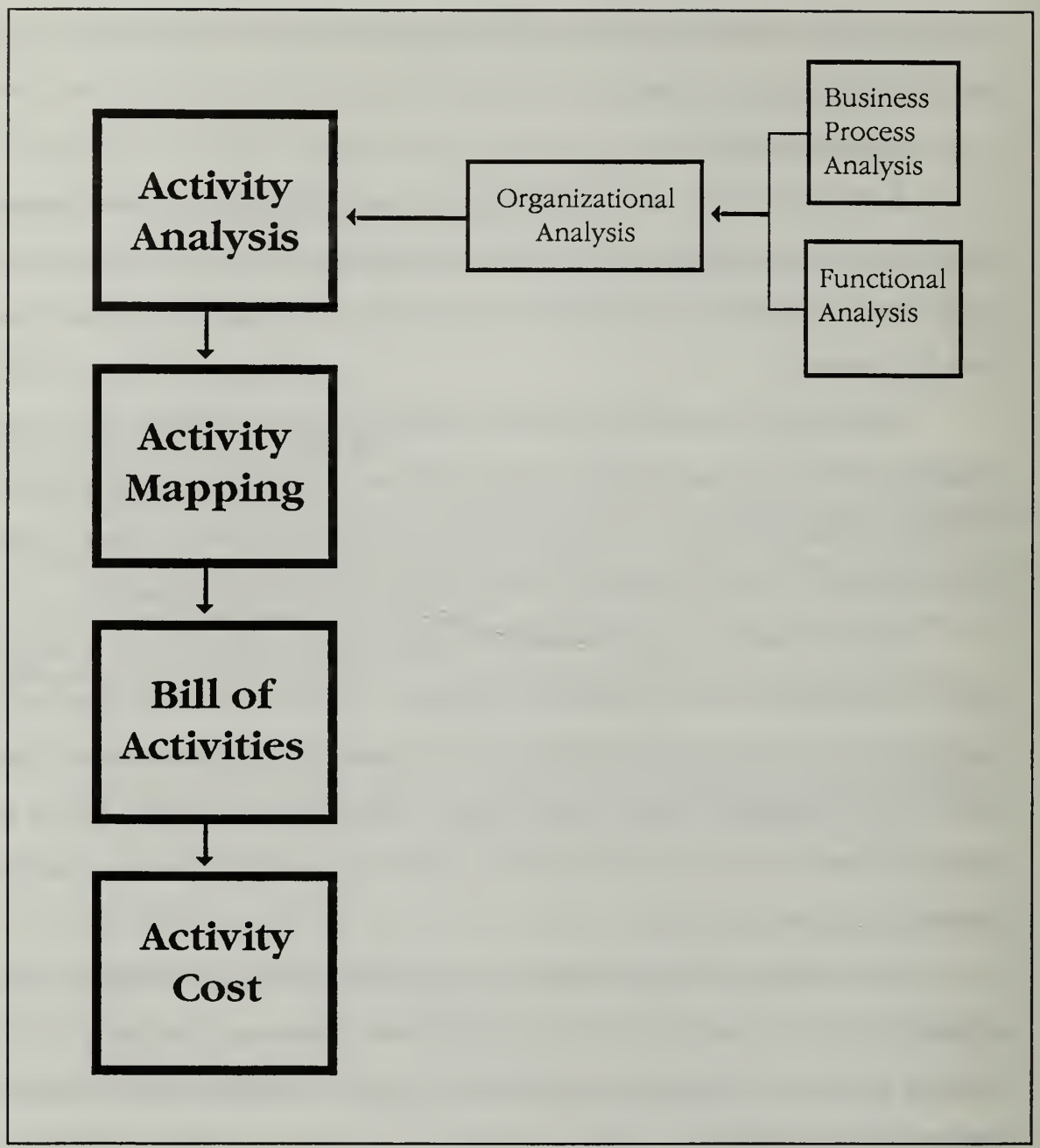

Figure 3. Evaluating Activities

- The activity is analyzed as it exists at the time the analysis is performed; not as it *once* existed in the past, not as it is *supposed* to exist and not as it exists in *similar* organizations.

- The occurrence of activity workload patterns defines what hour, day and month inputs are engaged in production or service.

- Activities should be defined with a noun and a verb. Activity titles may be persons, places or things that are integral to a particular activity. [Ref. 14:p.84]

- The analysis depends heavily upon reconciling information gathered through interviews, log books, organization charts, job descriptions, historical records, cost & performance reports and observation. [Ref. 14:p.93]

An activity analysis worksheet based upon sample data from the BMC X-ray department is displayed in Appendix H. Each activity that represents the sum of significant inputs into department operations is listed under the column labeled "Activity." A brief yet comprehensive definition of each activity is provided under the "Description" column. The "Time" column defines the measure of time ordinarily required to complete each activity. The final column classifies each activity as either a primary or secondary output.

Activity analysis is an exercise in analyzing time use. It provides a set of discretely structured activities that communicate what an organization or work center does.

2. Activity Mapping

In constructing an activity map, the recording of activities in a flow chart, or activity pattern, decomposes the business process into a network of activities. It further defines relationships between other functions, or linkages between primary and secondary activities not previously recognized. As activities are mapped, they are characterized in terms of units of time and chronological time periods. Mapping activities aids in illuminating those inputs that trigger activities and those outputs which represent activity products.

It also serves as a graphical representation of the dichotomy between primary and secondary activities. Thus, as resources are consumed in a work center, an activity map sets the stage for describing the flow of costs by clarifying activity outputs.

An activity map plotted from BMC X-ray department sample data is depicted in Appendix I. The general sequence of primary activities is initiated by a patient presenting an X-ray request form to the front desk. Depending on the type of film series called for, anywhere from one to seven minutes is required to lead the patient to the X-ray machine, position the machine and expose the patient. After processing the film, the chain of primary activities concludes with delivering the "output" film product to the physician. Secondary activities which serve to support the primary sequence of activities are displayed in a separate column.

The activity map in Appendix I graphically describes the charting of activities using the business process approach. Appendix I portrays activity solely in the X-ray department of the BMC model. To generate an activity map for the entire organization, a second map is necessary to plot business processes to functions. [Ref. 14:p.96,97]

3. Bill of Activities

The bill of activities (BOA) is a tool for uncovering the cost of providing a specific service such as: "repair fractured arm", "treat kidney infection." The activity cost of a distinct health care delivery event is the sum of all the significant activities triggered by the presentation of a patient complaining of an ailment such as lower back pain or arm pain.

This section examines the cost components relating activities to the X-ray department function. Thus, the bill of activities is constructed describing those business processes generic to the X-ray department. Furthermore, the bill of activities generates a final cost for each set of primary activities producing a particular health care product or service (e.g. knee series, ankle series, abdomen series). Ideally, a

costed bill of activities for products or services is generated from the compilation of all the bill of activities' derived from business processes [Ref. 14:p.187]

Costs are traced to a cost objective through the bill of activities, which specifies the sequence of activities and the cost of resources consumed in each process. For the BMC X-ray model, the sequence of primary activities consists of a patient checking into the front desk, the patient receiving an X-ray exposure, returning the patient to the waiting area, material related costs and film processing. Secondary activities consist of personnel training, answering the phone, filing and forwarding films. The secondary activities are traceable to the cost objective but are not included in the bill of activities (Appendix J).

Each patient approaching the desk in the X-ray department triggers an event when they hand over an X-ray request form signed by a physician. The X-ray form is the input, or activity measure, that triggers a unique activity. If the X-ray form indicates a knee series, more time and resources are consumed resulting in an overall higher activity cost than if the X-ray form indicated a chest (PA) X-ray for a physical examination. Each process is discussed as follows.

a. Administrative Check In:

Each process in the bill of activities has an associated cost. Administratively checking in each patient is a labor consuming activity that requires approximately three minutes and .441 cents in labor dollars.

b. Patient Exposure:

The process of exposing a patient to X-rays is also a labor consuming activity and represents a product of direct labor dollars per hour and is a function of the time required to perform a particular series. Positioning a patient for a simple chest X-ray is less time consuming than for a series that is difficult or awkward for the patient to maintain during film exposure.

c. Film Series:

The film series category of the bill of activities includes the direct material costs of X-ray film as derived from Appendix A. This expense represents the material cost of the specific activity, or film series, ordered by the physician.

d. Patient Return:

The process of returning the patient to the waiting area is critical when the individual suffers a traumatic injury. It is a labor intensive activity consisting of the product of direct labor dollars per hour and the approximate time required to remove the patient from the X-ray machine to the waiting area.

e. Film Processing:

Includes the material related cost for chemicals and the direct labor dollars per hour for completing the task. To process one film requires approximately three minutes, or .441 cents in direct labor dollars. The cost per film in consumption of chemicals is approximately .09 cents.[8]

Note that Table 2 (page 31) presents a total activity based cost figure in first quarter X-ray department consumption of $17,721. On the other hand, Table 1 (page 19) under full costing reports a total cost for the first quarter of $17,787. The difference of $66 may be attributed to the cost assigned under activity based costing to the dollar amount of chemicals consumed per X-ray film processed. Since this value is an estimate based upon total annual consumption, a more accurate cost may be determined by examining a five year period or by varying the cost per film as a function of consumption in each quarter, or even each month.

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[8]This figure is an approximation derived from the total cost of chemicals purchased in FY90 divided by the total number of films exposed in the same time period. Although the figure is arbitrary, it provides the nearest value of the actual cost of chemicals relative to activity.

f. Primary Activity Cost:

The primary activity cost represents the cumulative costs associated with producing a specific film series. The primary activity cost is combined with the secondary activity costs and overhead to arrive at a final cost objective. Brimson recommends a conservative treatment of overhead by choosing a relevant allocation base. [Ref. 14:p. 181]

The primary activity cost is the aggregation of costs essential to patient identification, to patient positioning, to patient exposure and to film processing. Costs that support the execution of primary activities are secondary in nature. Furthermore, resources are consumed to maintain a safe, temperate and healthy environment for patient care. Hence, overhead costs must be included to accurately reflect the total cost in delivering health care activities. A discussion of secondary activities and overhead costs follows.

4. Secondary Activities

Secondary Activities which support the performance of primary activities in the delivery of X-ray department health care products, are divided into four separate categories. Secondary activities consist of training, answering the phone, filing film records and unspecified direct labor. Each secondary activity is examined to identify an appropriate allocation base for determining cost variation. Secondary activities use direct labor hours for an allocation base since each of the four activities are linked to a labor consuming event or process in support of the primary activity of taking X-rays.

The allocation base computed for the three x-ray division personnel amounts to 1440 hours per quarter which assumes a 40 hour work week. The combined salaries per quarter for all three personnel is approximately $12,705 and is relevant for determining the proportion of labor cost allocated to each secondary activity. An examination of each secondary activity and its allocable cost follows.

a. Training:

Required training for active duty technicians occurs weekly and amounts to approximately two hours per week per technician. Ongoing education is not only required for military education but for maintaining Quality Assurance standards in health care delivery. New techniques, reviewing standard protocols or learning how to operate new equipment is a major part of regular training. This amounts to approximately 48 hours a quarter, which applied against total labor hours (1440) comes to a fraction of .033. Using the first quarter of fiscal year 1990 as an example (Appendix L), the total cost for performing the training activity under the X-ray department amounts to $419.

b. Answer Phone:

Phone use is an estimated figure arrived at through interviewing X-ray department personnel. Ideally, observation provides a more accurate forecast of telephone consumption. This is difficult to quantify and impractical to monitor, furthermore, phone bill records do not provide the level of detail necessary to make this assessment. It is estimated that phone related activities account for as much as one hour out of a given day, and are generally consumed in varying amounts by all department personnel. This accounts for approximately 60 hours per quarter and represents a proportion of .042 using total labor hours as the allocation base. Applying the model of the first quarter of fiscal year 1990 (Appendix L), the total cost for performing the phone answering activity under the X-ray department amounts to $927.

c. Forwarding & Verifying Films:

The hospital radiologist actively monitors the quality of films taken at the BMC, and serves as a consultant on complex matters relating to medical radiography and risk management. Films that require reading by a credentialed Radiologist must be sent to the hospital by courier. The films are read, and the Radiologist records his

impression in the remarks section of the X-ray request form. The films are replaced in their shipping envelope and returned to the clinic X-ray department. Upon receipt, films and forms are verified for patient identification purposes, and then separated and archived appropriately. One copy of the completed X-ray request form goes on file in the department and the other is permanently filed in the patient's health record.

The process of forwarding films consumes approximately 45 minutes per day per technician. To verify, sort and file films that are returned along with associated forms, requires approximately 60 minutes per day per technician. To perform this task requires 105 hours per quarter and results in an allocation base of .073. Thus, in the first quarter of fiscal year 1990, the total cost for performing the film forwarding activity amounts to $533.

d. Other Direct Labor:

Labor associated with idle time, unobserved activities or unreported activities is aggregated into the other direct labor category. It consists of those immeasurable activities unrelated to taking an X-ray, training, answering the phone or forwarding and collating films. It does not take into account vacation time or management concerns which could still be considered legitimate activities within the rubric of the X-ray division entity. It does assist in accounting for that margin of the regular work day which does not fully address previously mentioned activities, but is directly associated with total labor consumed. The proportion assigned to other direct labor is .734. Using data from the first quarter of fiscal year 1990, the total cost for performing activities associated with unspecified labor under the X-ray department amounts to $8,645.

5. Overhead

Support activities in traditional cost reporting systems are included in overhead and allocated to products on a direct basis using an allocation base such as direct labor,

machine hours, or materials. Ideally in activity based costing systems, support activities are directly traceable to the service, or health care product they support. [Ref. 14:p. 184]

Attempting to directly trace activities associated with heating, electricity and janitorial services (overhead) is not possible. These costs must somehow be allocated to activity performance without causing significant distortion. [Ref 14:p. 186] Consequently, janitorial service is allocated based on the square feet of space cleaned as described under the full cost reporting system. Heating costs are also allocated based upon square footage as performed under the full costing model. Electrical consumption is allocated based upon energy potential similar to the full costing model. The total overhead cost represents the sum of these expenses which amounts to $1,832 for the first quarter, fiscal year 1990.

E. TOTAL ACTIVITY COST

In the Cost Schedule Breakdown (Appendix L), a measure of the total activity consumption for the first quarter fiscal year 1990 amounts to $17,721. This cost report should prove useful to the manager for it disaggregates activity costs into primary, secondary and overhead cost pools. The manager can examine the cost of support activities relative to primary activities and overhead. Although the arrangement of costs is based upon activities and not fixed and variable costs, the total cost figure closely approximates the value described under full costing.

The Cost Schedule Breakdown (Appendix L) can be further disaggregated to give a cost value by X-ray series for the quarter. This provides the manager with the cost of performing a specific health care service or delivering a certain product. Using patient volume as an allocation base, Appendix M describes the allocation of secondary activities and overhead to primary activities based upon patient volume. For example, under the first quarter fiscal year 1990, the patient volume for performing a

knee series was 72 patients. Using total patient volume for the quarter, a proportion of the consumption of secondary activities and overhead can be allocated to the knee series activity resulting in a total activity cost for performing X-rays of knees during the first quarter amounting to $1,014.

F. SUMMARY

This chapter discussed step by step the development of an activity based cost reporting model derived from BMC workload data during 1990. First introduced was a list of critical terms associated with cost allocation techniques for applying indirect costs, and activity-related costs based on previous research by James Brimson. This was followed by a comparison between the present partial cost reporting system to the proposed activity based system. The next section focused on activity behavior, and the dissection of the BMC X-ray division into distinct activity products. Using activity analysis, activity mapping and a bill of activities, a cost management system was created based upon "what an enterprise does," and "the way time is spent." Such an activity based cost reporting system should provide the manager with a better understanding of the cost of operating an X-ray department.

Full costing and activity based costing provide the manager with better tools to manage the cost of labor, materials and overhead that go into producing a particular health care product. By having a cost reporting system that produces a better measure of the cost per patient, health care managers have greater opportunities to address the inconsistencies of reactive versus proactive, barriers to costing information, centralized costing data, and historical based budgeting. With increased confidence in their cost reporting systems, managers are able to improve decision-making.

In the next chapter, an examination of the results of the full cost reporting system and the activity based cost reporting system provide an opportunity to contrast and compare the two systems.

V. IMPLICATIONS AND RESULTS

A. OVERVIEW

In the previous two chapters, a single cost measurement for a BMC X-ray department generated from an existing cost reporting system was disaggregated and enhanced to create two distinct cost information systems. The full costing model that was developed distinguishes between fixed and variable costs. This reveals a more complete picture of operating expenses in the sample X-ray department. The second model used the same expense data to examine those activities that generate costs. In the activity based model, a different philosophy of cost accumulation creates a unique story of how inputs are consumed to deliver outputs.

In this section, those weaknesses in the present system originally expressed by BMC managers are re-explored. This chapter asks the questions: Do the two proposed costing systems succeed in providing the manager with improved information on workcenter operations? This chapter focuses on a review of the weaknesses of the present system as reported by BMC managers, but in light of the improvements offered by the two new costing methodologies. The strengths and weaknesses of each proposed system are analyzed and compared. Upon conclusion of this chapter, the reader will possess a greater understanding of the advantages and disadvantages of a full cost reporting system and an activity based cost reporting system.

B. COST REPORTING SYSTEMS

Appendix K presents a cost report for the BMC X-ray department based on full costing. Variable costs are made up of direct materials and electricity. Where patient

volume is unpredictable and inconsistent, material costs in the form of X-ray film vary with patient demand. Furthermore, electricity periodically fluctuates with energy demands. Fixed costs include chemicals, direct labor and indirect labor. Chemicals are consumed at a constant quantity regardless of patient volume. Labor is also constant irrespective of sick leave or regular leave because salaried individuals continue to receive pay while on vacation or during an illness.

Appendix M presents a cost report for BMC X-ray based on activity based costing, and gives the manager the total cost each quarter to perform a specific X-ray series. Secondary activity costs and overhead are allocated to the primary activity costs based upon patient volume. The cost of a specific series based upon activities represents the sum of labor, materials and overhead that went toward delivering that particular health care product.

1. Influence on Reactive Versus Proactive

As discussed in Chapter II, managers believe they are forced to "react" to budget ceilings rather than to plan and project strategic requirements. This is due to the dependence on a cost reporting system under partial costing that does not provide salient information because the BMC manager gets a single cost figure only. BMC managers complain of an inability to interpret costs because the information provided under the present cost management system is "meaningless." Hence, the manager's field of vision is narrow or myopic.

Using a full cost reporting system, the manager is not restricted to the current "checkbook" method of accounting for costs in an OPTAR log. For example, under the present partial cost reporting system, chemicals and X-ray film costs are included under the same account code. Using full costing methods, the constant fixed cost for chemicals is separated out. Significant information is revealed on the variable cost

behavior of X-ray film. The BMC manager is not restricted to a narrow field of vision and is able to observe any changes in cost for X-ray film from the first through the fourth quarters.

Using activity based costing, the BMC manager is able to shift attention away from budget ceilings to those workcenter activities that ultimately drive costs. Each specific cost is uniquely attributable to a primary activity. As primary activities fluctuate in proportion to volume, the total cost for performing X-rays changes. Secondary activities in the form of training, answering the phone, filing records and unspecified direct labor contribute to the support costs for X-ray department operations. As in the full costing model, activity based costing allocates indirect labor, heating and electricity which form the overhead costs to primary activities.

Primary and secondary activities yield valuable information for the BMC manager regarding department operations. For example, a simple examination of primary costs reveals a startling dependence on asbestos screening (Appendix M). Roughly forty-six per cent of the cost of primary activities is associated with screening shipyard workers for asbestos in lung tissue. This information is unavailable under the full costing system.

2. Influence on Historical Based Budgeting

Under historical based budgeting, managers become dependent upon prior year budget ceilings to justify future work center requirements. Budget ceilings do not explain away changes in the patient population base, they merely inform the manager of the availability of more or less funding than the previous year.

Where the manager is presently required to predict future operating expenses from historical data, the full costing system increases the managers confidence in strategic planning. The manager can use the knowledge gained of the fixed or variable nature of costs to predict how total costs might change as a function of patient volume.

For example, in the event a cruiser is decommissioned or relocated, the manager is able to perform a cost projection based on simple arithmetic for the expected impact of decreasing the patient population base by 900 sailors.

Under the partial costing system, this cost analysis would prove awkward. As depicted in the full cost report (Appendix K), identifying and extracting fixed costs is instrumental in examining variable cost. The manager can assume no change in fixed costs, most notably chemicals and indirect labor. Direct labor also remains constant, although an examination of additional labor support needs may prove informative. The variable cost of electricity may not be significantly affected, but direct materials are. Analyzing the patient behavior patterns associated with Cruiser populations in the past provides a reasonable approximation of the general outpatient case mix. This allows the BMC manager to plan and project future patient demand.

Activity based costing examines the same costing data only arranged in a different format. By examining the cost of providing health care service as a product of activities, materials and energy inputs, the manager is able to shift from a dependence on historical based consumption to prospective resource consumption. Continuing the analogy of a Cruiser relocating to a new homeport, once the approximate case mix for a Cruiser population is determined, the increased labor activity is easily calculated. Thus, the need for additional labor is driven by the volume of increased activity an additional cruiser creates. Labor is more accurately estimated under the activity based model because the activities are driven by people. Unlike the manufacturing sector, the service environment is labor intensive.

Furthermore, the manager is able to justify future demand by planning for the additional supplies needed to support the Cruiser. The manager must be able to determine the approximate mix (commonly referred to as case mix) of film series ordered when 1,000 men on a Cruiser are included in the population base. This is

possible through studying the general demand for medical care by an already existing homeported Cruiser population.

3. Influence on Barriers to Costing Information

Under the present system of cost management, the BMC manager never receives information on, nor is held accountable for non-controllable labor and utility costs. The BMC manager consumes electricity, gas and labor resources but is ignorant of their impact on operating expenses. As in the analogy of the buggy horse wearing blinders, the horse plods along knowing a great deal about dust, mud and potholes, yet is unaware of the total vista surrounding him. So it is with the BMC manager.

The BMC manager gains substantial information about clinic operations under a full cost reporting system. Costs traditionally charged to other departments or kept in the hospital fiscal department provide the manager a more comprehensive story regarding operations. The full cost report (Appendix K) illustrates the segregation of heating, electricity, direct and indirect labor into categories of fixed and variable costs. The manager is able to observe trends in variable costs as they fluctuate relative to fixed costs. If a fixed cost suddenly increases, the manager can explore possible reasons for the increase, and thus improve his understanding of cost relationships as well as assist in explaining away the inconsistency. This would be very difficult to do under the current partial cost system.

Under activity based costing, each activity that generates an associated cost is measured, and thus any barrier to information reporting is removed. The activity based model is dependent upon dissecting activities into their elemental cost components (Appendix L). Once grounded in a firm understanding of workcenter behavior, costs associated with training, answering the phone, filing reports and films as well as other secondary activities are traceable to the primary delivery of a knee series product, or

the delivery of a shoulder series product. Furthermore, removing cost information barriers through activity analysis yields opportunities for quality improvement. [Ref.16:p.24] Often, an examination of labor behavior patterns results in modifying old procedures to eliminate waste and redundancy.

4. Influence on Centralized Costing Data

BMC managers currently experience limitations in the scope of their cost systems due to the centralization of financial data at the comptroller department. The BMC manager is not being held fully accountable for operations and is not being provided with cost data relevant to clinic operations. BMC managers complain of feeling "powerless, managing in a vacuum" and handicapped by an "inflexible system."

The full costing model decentralizes the reporting of direct and indirect labor expenses as well as pertinent heating and electrical costs. Cost information available under full costing removes much of the obscurity experienced in the present partial costing system.

Under activity based costing, each activity bears an associated cost. Consequently, all "significant" cost relationships are defined and expenses are allocated to a pre-defined cost objective. Any pertinent cost is decentralized and reported under such a cost information system.

As discussed in the previous section, pertinent costing data retained at the hospital offers rich insights into the behavior and function of the X-ray workcenter. For those managers operating in a vacuum, the flow of relevant cost information is currently inadequate and centrally contained. Empowering the BMC manager through decentralizing cost information increases the manager's ability to influence outcomes.

C. SUMMARY

This chapter discussed both the full costing and the activity based costing systems in light of previous complaints registered by BMC managers. Advantages and disadvantages of both cost reporting systems were mentioned. Both systems suitably dis-assemble costing information reported under the current partial costing system. For the manager, it is most beneficial to view operational expenses in terms of fixed and variable costs, direct and indirect costs, controllable and non-controllable costs as well as activity based costs.

The next chapter forms the concluding remarks for this thesis. Lessons learned and opportunities for further research are discussed.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. OVERVIEW

This thesis starts from the premise that the existing partial costing system in Navy Branch Medical Clinics is not providing the BMC manager with pertinent cost information. It proposes two distinctly different cost reporting systems for enhancing the cost information available to BMC managers.

Cost information systems currently in place provide minimal assistance to the manager in executing decisions and achieving greater efficiency. By expanding and disaggregating expense information by using a full cost reporting system or an activity based costing system, a more comprehensive view of operations is uncovered. By scrutinizing those activities which contribute toward cost accumulation, a new perspective on the cost of performing health care delivery is formulated.

Four basic criticisms of the current partial cost reporting system were identified in Chapter II. After introducing full cost reporting in Chapter III, activity based costing was presented in Chapter IV. Chapter V then discussed the advantages and disadvantages of each system as a managerial tool for improving decision making and eliminating waste.

This chapter begins with a brief review of the lessons learned and their implications for improving the four generic complaints registered by BMC managers as previously discussed. Next, a discussion of how the proposed cost reporting systems could be implemented in a Navy health care facility is presented. This is followed by a recommended approach to implementation. Upon conclusion of this chapter, the

reader will have an understanding of cost accumulation in a health care setting and how the present method of reporting costs can be potentially enhanced.

B. LESSONS LEARNED

1. Reactive Versus Proactive

The budgetary cycle conditions managers to restrict their field of vision to budgetary ceilings. Relative to the present system, the proposed systems of cost management shift the manager's focus away from budget ceilings and concentrate the manager's attention on the costs incurred.

Under the full costing system, the manager gains an appreciation of costs that are disaggregated and more detailed. Distinguishing between fixed and variable costs, and direct and indirect costs allows the manager an increased opportunity for examining those factors that drive cost and for executing decisions that generate changes toward more efficient resource consumption.

In the case of activity based costing, activities and costs illuminate the expense of performing health care delivery. Providing more detailed cost reports is extended from the full cost reporting system to activities, processes and actions. Cost detail is examined at the level of performing specific tasks. Thus, activity based costing gives the manager a different perspective on cost.

For the BMC manager, cost information is enhanced and opportunities for decision making are improved by shifting focus away from budget ceilings, and onto pertinent cost relationships. Activity based cost reporting and full cost reporting expand the manager's field of vision and thus the ability to influence outcomes.

2. Historical Based Budgeting

Too often under the current system the previous year's operational performance is used to justify next year's budget request with little consideration to

forecasting needs or projected patient demand. This is partially due to the volume of data the manager must sift through to arrive at relevant costing information. Both proposed cost reporting systems enhance the manager's understanding of resource consumption in the workcenter as well as the manager's ability to influence positive outcomes. Under the full cost reporting system, the manager is provided with specialized tools to perform reasonably effective projections of future consumption. The ABC model specifies the cost of elemental activities thus providing the BMC manager with significant power to forecast expenses.

3. Barriers to Costing Information

Costs under the current partial cost system are charged directly to the BMC, or to other workcenters. Barriers that prevent the manager from gaining insight on the relevant costs associated with BMC operations are removed with the full cost reporting system or activity based cost reporting. Hence, the proposed systems make cost analysis easier for the BMC manager.

For example, information regarding electrical consumption is currently reported only to the civil engineer. Were the BMC manager to receive this information, efforts could easily be initiated to control costs during peak usage periods (Appendix G). Furthermore, understanding those work centers that experience high electrical consumption, and therefore drive up energy costs, is instrumental in giving the BMC manager a better understanding of facility operations and work center relationships. Without pertinent cost information, or a complete understanding of resource consumption in the workcenter, the manager cannot confidently execute cost-relevant decisions.

4. Centralized Costing Data

By decentralizing accountability, and thus creating an incentive for managers to be aware of the associated costs that drive clinic resource consumption, managers become more knowledgable of work center activity. The full cost reporting system

enhances the manager's cost information thus improving decision making. The activity based cost reporting system highlights costs that cannot be readily associated with primary activities and hence may illuminate waste and redundancy. [Ref. 17:p. 95] Thus, by decentralizing cost information, the BMC manager is made aware of the cost relationships existing among workcenters.

C. IMPLEMENTATION

This thesis proposes two different methods for reporting costs over the present partial cost system. Restructuring the current cost reporting system to a full costing model may require less effort than to install an activity based cost reporting system. Modifying the present "checkbook" or partial cost reporting system to a full cost reporting system requires reorganizing some already existing cost information, and introducing some new cost information. Ensuring overhead and labor is included in the costing system is the only major change. Examining materials and dividing up fixed versus variable costs is a relatively simple task.

In contrast, activity based costing requires a serious commitment to time and resources since it entails creating a new cost reporting system organized around activites rather than cost centers. Performing the first stage of activity analysis requires interviewing key personnel as well as observing and documenting activities. These events must occur horizontally across the organization before activity mapping and the bill of activities can match elementary processes to the ultimate activity products.

This thesis has investigated activity based costing in only a fragment of a total health care organization. To precisely define the activity cost of suturing a minor laceration, splinting a fractured arm or dispensing pharmaceuticals requires an examination of processes occurring in a variety of departments. Consequently, attempting to implement activity based costing at a Navy Branch Medical Clinic may be more costly to start up and maintain. [Ref. 10:p. 17]

Periodically, "activity audits" would need to be conducted to ensure that the organization's activity based cost system accurately reflects activity behavior at the technical level. Contracting out to private industry may be less expensive initially, yet ongoing maintenance costs may make the proposal cost prohibitive. Determining the cost versus the ultimate benefit of investing resources into activity based costing is a subject worthy of future research.

D. RECOMMENDATIONS

This thesis focuses on improving the information provided by a cost reporting system in a health care setting. The systems offered to enhance cost relevancy consist of full costing and activity based costing. Since this study focuses on one department of a multi-faceted health care organization, studying the effects of full costing and activity based costing in all departments of a BMC simultaneously may generate different results on how costs are reported. Further exploration of full costing and activity based costing at the BMC level should consider the potential benefits of learning what these two proposed cost reporting systems can do for the manager when including all workcenters.

Implementing an activity based costing system not only demands dedicating what may be a non-rtivial amount of labor to creating a different cost information system, but it also necessitates interrupting staff members in the performance of regular health care delivery functions for data collection and interviews. For any organization, finding the resources and personnel to support such an endeavor may prove too costly.

Implementing activity based costing at the BMC would not be possible for the BMC manager to perform alone. Although a Naval Hospital is not fully staffed for such an undertaking, were it to shift resources toward focusing on activity based costing on a limited scale, support could be provided. Furthermore, a small number of hospital

staff members are expert in management control and auditing, and could easily be trained to analyze activities.

Each large Naval Hospital is staffed with management control review specialists mandated by Navy directive to perform regular reviews of in-house management control systems. [Ref. 18:p. 2] It is their responsibility to periodically audit areas of the facility that are sensitive to theft, fraud or mismanagement. This audit evaluation is maintained by the host facility and does not have to be forwarded to any external agency or senior authority. [Ref. 19:p. 2]

The Efficiency Review Program is another mandated program that is an extension of the Management Control Program. [Ref. 20:p. 1] The Efficiency Review Program requires that Naval Hospitals periodically conduct industrial engineering studies, referred to as Task Activity Listings. [Ref. 21:p. 4] These studies are almost identical with the activity analysis phase presented in this thesis. Task activity listings could be extended to activity analysis and even generating a bill of activities.

The benefit to implementing activity based costing internally is in its selective application for identifying waste and inefficiency. As a tool for management review, activity based costing could point the way toward possible policy improvements or redundant taskings that could be eliminated. By targeting specific workcenters that may be more susceptible to inefficient practicies, activity based costing could reveal avenues for enhancing efficiency, reducing costs and eliminating waste.

In the course of implementing activity based costing under the auspices of management control/efficiency review, the activity based costing process should not be misconstrued to be an audit tool. Auditing is a separate function with different objectives. Activity based costing under the umbrella of internal review could be an effective management tool for strategic planning, financial planning and quality improvement.

Further research into the variety of activity based costing software in the marketplace may reveal automated systems that reduce the investment cost of implementing an activity based cost information system. [Ref. 22:p. 18]

E. SUMMARY

This chapter revisited the lessons learned from complaints voiced by BMC managers. Then, a discussion of how a full cost reporting system and an activity based cost reporting system could be implemented in a Navy health care facility was presented. This was followed by a recommended approach to implementation.

This thesis examined cost reporting at a Navy Branch Medical Clinic. Costs which were traditionally reported under a partial cost reporting system were modified to create a full cost reporting system. Under the traditional system, one figure represented total consumption for each reporting period. Under the full costing model, costs were disaggregated into fixed and variable components. The thesis further explored the effects of activity based cost reporting. Using the Brimson approach, costs were reported as a function of the activities that drove cost.

APPENDIX A

X-RAY FILM COST PER PROCEDURE

	Film Size (in Cm.)	Number of Films in Series	Cost of Film per Unit of Issue	Total Cost per Series
Knee Series	24x30	Two	$64 per 100	$1.28
Hand Series	24x30	Two	$64 per 100	$1.28
Cervical Spine	24x30 and 24x24	Two One	$64 per 100 $76 per 100	$1.28 + .76 =$2.04
Shoulder Series	24x30	Two	$64 per 100	$1.28
Elbow Series	24x30	One	$64 per 100	.64
Chest (PA)	35x43	One	$132 per 100	$1.32
Chest Acute	35x43	Two	$132 per 100	$2.64
Chest Asbestos	35x43	Two	$132 per 100	$2.64
Ankle Series	35x43	Two	$64 per 100	$2.64
Abdomen	35x43	Three	$132 per 100	$3.96
Acute Abdomen	24x30	Two	$132 per 100	$2.64

APPENDIX B

X-RAY DEPARTMENT VOLUME

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
Knee Series	72	105	114	89
Hand Series	65	98	138	148
Cervical Spine	44	41	32	44
Shoulder Series	46	33	41	40
Elbow Series	36	19	34	39
Chest (PA)	281	272	420	323
Chest Acute	119	149	104	148
Chest Asbestos	517	553	527	665
Ankle Series	59	74	89	88
Abdomen	12	19	35	48
Acute Abdomen	11	13	11	12
Total	**1262**	**1376**	**1545**	**2660**

APPENDIX C

QUARTERLY FILM COST AS A FUNCTION OF VOLUME

	1st Quarter		2nd Quarter	
	(cost per series) x (series performed)	Total	(cost per series) x (series performed)	Total
Knee Series	(1.28)(72)	$92.16	(1.28)(105)	$134.40
Hand Series	(1.28)(65)	$83.20	(1.28)(98)	$125.44
Cervical Spine	(2.04)(44)	$89.76	(2.04)(41)	$83.64
Shoulder Series	(1.28)(46)	$58.88	(1.28)(33)	$42.24
Elbow Series	(.64)(36)	$23.04	(.64)(19)	$12.16
Chest (PA)	(1.32)(281)	$370.92	(1.32)(272)	$359.04
Chest Acute	(2.64)(119)	$314.16	(2.64)(149)	$393.36
Chest Asbestos	(2.64)(517)	$1364.88	(2.64)(553)	$1459.92
Ankle Series	(2.64)(59)	$155.76	(2.64)(74)	$195.36
Abdomen	(3.96)(12)	$47.52	(3.96)(19)	$75.24
Acute Abdomen	(2.64)(11)	$29.04	(2.64)(13)	$34.32
		$2629.32		**$2915.12**

APPENDIX C (continued)

QUARTERLY FILM COST AS A FUNCTION OF VOLUME

	3rd Quarter		4th Quarter	
	(cost per series) x (series performed)	Total	(cost per series) x (series performed)	Total
Knee Series	(1.28)(114)	$145.92	(1.28)(89)	$113.92
Hand Series	(1.28)(138)	$176.64	(1.28)(148)	$189.44
Cervical Spine	(2.04)(32)	$65.28	(2.04)(44)	$89.76
Shoulder Series	(1.28)(41)	$52.48	(1.28)(40)	$51.20
Elbow Series	(.64)(34)	$21.76	(.64)(39)	$24.96
Chest (PA)	(1.32)(420)	$554.40	(1.32)(323)	$426.36
Chest Acute	(2.64)(104)	$274.56	(2.64)(148)	$390.72
Chest Asbestos	(2.64)(527)	$1391.28	(2.64)(665)	$1755.60
Ankle Series	(2.64)(89)	$234.96	(2.64)(88)	$232.32
Abdomen	(3.96)(35)	$138.60	(3.96)(48)	$190.08
Acute Abdomen	(2.64)(11)	$29.04	(2.64)(12)	$31.68
		$3084.92		**$3496.04**

APPENDIX D

LABOR EXPENSE

			Base Pay	Quarters Allowance	Per Month	Per Hour
DIRECT LABOR	**Active Duty***	E-5 Over 6 years	$1218	$252	$1470	$9.20
		E-5 Over 6 years	$1218	$252	$1470	$9.20
	Civil Service**	GS-4 Step 3	$1295		$1295	$10.79
	Total				$4235	$35.29
INDIRECT LABOR	**Civil Service*****	WG-4 Step 4	$1163		$1163	$9.69
		WG-3 Step 3	$1052		$1052	$8.77
	Total				$2215	$18.46

* Navy Times Pay Chart, *Navy Times Magazine*, 1January 1990, p. 31.

** Federal Times Pay Chart, *Federal Times Magazine*, 1 January 1990, p. 24.

*** Wage Rate Schedule for U.S. Citizens, Office of Personnel Management letter 532-138 of 29 March 1989.

APPENDIX E
SPACE UTILIZATION

Work Center	Square Feet of Space
Laboratory	1800
Supply	2160
Primary Care	4594
Pharmacy	896
X-Ray	2704
Physical Exams	1920
Medical Records	1400
Administrative Areas	1410
Sum of Common Areas	4044

Total Square Feet = 20,928

Common area apportioned among eight departments is 4044 sq.ft. / 8 = 505 sq. ft.

X-ray as a percentage of total square feet plus shared portion of common area =

$$\frac{2704 + 505}{20928}$$

= 15.3% or .153

APPENDIX F

FY 90 BRANCH MEDICAL CLINIC CONSUMPTION*

	ELECTRICITY ($.107 per Kwh)**											
MONTHLY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	$3082	$3219	$3013	$7670	$2671	$2739	$2671	$2055	$3356	$2876	$$2945	$2808
QUARTERLY	First Quarter $9,313			Second Quarter $13,079			Third Quarter $8,081			Fourth Quarter $8,628		
	HEATING AND AIR CONDITIONING (Gas: $4.02 per mbtu)***											
MONTHLY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
	$627	$458	$621	$479	$483	$466	$91	$34	$50	$22	$20	$16
QUARTERLY	First Quarter $1,706			Second Quarter $1,427			Third Quarter $175			Fourth Quarter $58		

* Long Beach Naval Shipyard Records
** Kilowatt hour
*** British Thermal Units (in millions)

APPENDIX G

ELECTRICAL CONSUMPTION*

Department	Lighting	Equipment	Total
LAB	44 incandescent 1540W	Different diagnostic Instruments: 5894W	7934W
X-RAY	44 incandescent 1540W	2 X-Ray machines:200W 2 X-Ray processors: 80W 1 computer: 628W	2448W
PHARMACY	24 incandescent: 840W		840W
PRIMARY CARE	148 incandescent: 5580W		5580W
PHYSICAL EXAMS	24 incandescent: 840W	1 duplication machine: 1240W	2040W
MEDICAL RECORDS	14 incandescent: 490W	1 computer: 628W	1118W
SUPPLY	28 incandescent: 980W	1 computer: 628W	1608W
ADMINISTRATION	46 incandescent: 1610W	1 duplication machine: 1240W	4734W
PUBLIC AREAS	112 incandescent: 3920W	1 refrigerator: 840W 1 coffeemaker: 100W	4866W
TOTAL			30,668W

*Calculations are based upon a standard 120V power source. Watts are abbreviated as "W." The electrical consumption of public areas is decomposed and allocated in equal amounts to the eight departments.

APPENDIX H

ACTIVITY ANALYSIS

Activity	Description	Time	Classification
1. Knee Series	Radiographic examination of knee region exposing 2 (24x30 cm) films	7 min.	Primary
2. Hand Series	Radiographic examination of hand by exposing 2 (24x30 cm) films	3 min.	Primary
3. Cervical Spine Series	Radiographic examination of upper spine by exposing 1 (24x24 cm) and 2 (24x30 cm) films	7 min.	Primary
4. Shoulder Series	Radiographic examination of shoulder using 2 (24x30 cm) films	7 min.	Primary
5. Elbow Series	Radiographic examination of elbow using 1 (10x12 cm) film	5 min.	Primary
6. Chest (PA)	Radiographic examination of chest using 1 (35x43 cm) film. Used for physical examinations.	1 min.	Primary
7. Chest (Acute)	Radiographic examination of chest using 2 (35x42 cm) films. Diagnostic for pneumonia, bronchitis, cardiac emergencies (enlarged, overworked heart muscle).	1 min.	Primary
8. Chest (asbestos)	Radiographic examination of chest using 2 (35x43 cm) films. Diagnostic for asbestos exposure.	1 min.	Primary

APPENDIX H (continued)

ACTIVITY ANALYSIS

Activity	Description	Time	Classification
9. Ankle Series	Radiographic examination of ankle using 2 (24x30 cm) films	5 min.	Primary
10. Abdominal Series	Radiographic examination of abdomen using 2 (35x43 cm) films. Diagnostic for stool masses, sharp pains, lack of bowel sounds, rebound tenderness and kidney stones.	7 min.	Primary
11. Acute Abdominal Series	Radiographic examination of abdomen using 3 (35x43 cm) films. Diagnostic for multiple bowel sounds, gastric upset, gastrointestinal studies.	7 min.	Primary
12. Administration	Greet patient. Record name and request into department records and on morbididty report. Type I.D. template for films, review X-ray request for physician signature.	3 min.	Primary
13. Process Film	Each film is permanently marked with patient identification and is fed into the film processor to be developed and dried.	3 min.	Primary
14. Forward Films	Identify, inventory and package all films requiring transport to the hospital radiologist for definitive review and diagnosis.	45 min./ Day	Secondary

APPENDIX H (continued)

ACTIVITY ANALYSIS

Activity	Description	Time	Classification
15. Receive Films	Receive, verify and file films and associated reports on those studies reviewed and diagnosed by the radiologist.	60 min./ Day	Secondary
16. Answer Phone	Schedule X-rays, answer questions, respond to physician or patient needs.	60 min. / Day	Secondary
17. Training	Participate in ongoing education of a medical or military nature.	120 min. / Week	Secondary
18. Return Patient to Waiting Area	Assist patient in ambulating, or by other means, to the Waiting Area.	1 min. / patient	Secondary

APPENDIX I

ACTIVITY MAP

Primary	Secondary
Greet patient, check identification, record on department log and into morbidity reports, review X-ray request. (3 minutes)	Answer phone. Respond to physician or patient requests.
Patient is led into X-ray room. Patient is correctly positioned and X-ray machine adjusted. Patient receives exposure. (Variable)	Forward films. Identify, inventory and package all films requiring transport to the radiologist.
Patient is directed to waiting room area. X-ray machine is readjusted, X-ray film is picked up and taken to the processor. (1 minute)	Receive films. Verify and file reports and associated films.
X-ray film is removed from film carriage and placed into an identification stamp machine. Film is then placed into the processor for development. (3 minutes/ film)	Training. Participate in ongoing education.
Film "product" is attached to request form and either delivered to physician or given to the patient for delivery to physician.	

APPENDIX J

BILL OF ACTIVITIES

COST PER PROCESS:	ACTIVITY MEASURE:			
	KNEE SERIES	HAND SERIES	CERVICAL SPINE	SHOULDER SERIES
ADMINISTRATIVE CHECK-IN: Receiving patients is a direct labor input (3 minutes at $.153 per minute).	$.459	$.459	$.459	$.459
PATIENT EXPOSURE: Product of labor in dollars per minute and approximate time spent per patient for the specific series	(.153)(7min.) = $1.071	(.153)(3min.) = $.459	(.153)(7min.) = $1.071	(.153)(7min.) = $1.071
FILM SERIES: Cost of film for specific series ordered	$1.28	$1.28	$2.04	$1.28
PATIENT RETURN: Labor Cost to return patient to waiting area (1 min.).	$.153	$.153	$.153	$.153
FILM PROCESSING: The labor cost input per film is added to the chemical cost input per film. This value is multiplied by the quantity of films to be processed.	(.459+.09)2 = $1.098	(.459+.09)2 = $1.098	(.459+.09)3 = $1.647	(.459+.09)2 = $1.098
PRIMARY ACTIVITY COST	**$4.061**	**$3.449**	**$5.370**	**$4.061**

APPENDIX J (continued)

BILL OF ACTIVITIES

COST PER PROCESS:	ACTIVITY MEASURE:			
	ELBOW SERIES	CHEST (PA)	CHEST ACUTE	CHEST ASBSESTOS
ADMINISTRATIVE CHECK-IN: Receiving patients is a direct labor input (3 minutes at $.153 per minute).	$.459	$.459	$.459	$.459
PATIENT EXPOSURE: Product of labor in dollars per minute and approximate time spent per patient for the specific series	(.153)(5min.) = $.765	(.153)(1min.) = $.153	(.153)(1min.) = $.153	(.153)(1min.) = $.153
FILM SERIES: Cost of film for specific series ordered	$.64	$1.32	$2.64	$2.64
PATIENT RETURN: Labor Cost to return patient to waiting area (1 min.).	$.153	$.153	$.153	$.153
FILM PROCESSING: The labor cost input per film is added to the chemical cost input per film. This value is multiplied by the quantity of films to be processed.	(.459+.09)1 = $.549	(.459+.09)1 = $.549	(.459+.09)2 = $1.098	(.459+.09)2 = $1.098
PRIMARY ACTIVITY COST	**$2.566**	**$2.634**	**$4.503**	**$4.503**

APPENDIX J (continued)

BILL OF ACTIVITIES

COST PER PROCESS:	ACTIVITY MEASURE:		
	ANKLE SERIES	ACUTE ABDOMEN	ABDOMINAL
ADMINISTRATIVE CHECK-IN: Receiving patients is a direct labor input (3 minutes at $.153 per minute)	$.459	$.459	$.459
PATIENT EXPOSURE: Product of labor in dollars per minute and approximate time spent per patient for type of series	(.153)(5min.) = $.765	(.153)(7min.) = $1.071	(.153)(7min.) = $1.071
FILM SERIES: Cost of film for specific series ordered	$2.64	$3.96	$2.64
PATIENT RETURN: Labor Cost to return patient to waiting area (1 min.).	$.153	$.153	$.153
FILM PROCESSING: The labor cost input per film is added to the chemical cost input per film. This value is multiplied by the quantity of films to be processed.	(.459+.09)2 = $1.098	(.459+.09)3 = $1.647	(.459+.09)2 = $1.098
PRIMARY ACTIVITY COST	**$5.115**	**$7.290**	**$5.421**

APPENDIX K

FULL COST REPORT (FY 90)

	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter	TOTAL
VARIABLE COSTS					
DIRECT MATERIALS X-ray Film Expense defined as: (Volume and type of series) X (cost per series)	$2,629	$2,915	$3,085	$3,496	**$12,125**
ELECTRICITY	$908	$1,275	$788	$841	**$3,812**
FIXED COSTS					
CHEMICALS ($89/mo.) X (3 mo.)	$267	$267	$267	$267	**$1,068**
HEATING (.153) X (Volume mbtu)	$261	$218	$27	$9	**$434**
DIRECT LABOR ($4,235) X (3 mo.)	$12,705	$12,705	$12,705	$12,705	**$50,820**
INDIRECT LABOR, Janitorial ($6,645) X (.153)	$1,017	$1,017	$1,017	$1,017	**$4,068**
TOTAL	**$17,787**	**$18,405**	**$17,889**	**$18,335**	$72,327
AVERAGE COST PER PATIENT PROCEDURE	$14.09	$13.38	$11.58	$6.89	$10.57

APPENDIX L

COST SCHEDULE BREAKDOWN

PRIMARY ACTIVITIES	1st Quarter	2nd Quarter
Knee Series	(72) (3.959) = $285	(105) (3.959) = $416
Hand Series	(65) (3.371) = $219	(98) (3.371) = $330
Cervical Spine	(44) (5.250) = $231	(41) (5.250) = $215
Shoulder Series	(46) (3.959) = $182	(33) (3.959) = $130
Elbow	(36) (2.494) = $89	(19) (2.494) = $47
Chest (PA)	(281) (2.586) = $726	(272) (2.586) = $703
Chest Acute	(119) (4.437) = $528	(149) (4.437) = $661
Chest Asb	(517) (4.437) =$2,294	(553) (4.437) =$2,453
Ankle	(59) (5.025) = $296	(74) (5.025) = $371
Acute Abdomen	(11) (8.199) = $90	(13) (8.199) = $106
Abdomen	(12) (5.613) = $67	(19) (5.613) = $106
	$5,010	$5,543
SECONDARY ACTIVITIES		
Training	(.033) ($12,705) = $419	(.033) ($12,705) = $419
Answering Phone	(.073) ($12,705) = $927	(.073) ($12,705) = $927
Verify & File Films	(.042) ($12,705) = $533	(.042) ($12,705) = $534
Other Direct Labor	(.680) ($12,705) = $8,645	(.662) ($12,705) =$8,408
	$10,525	$10,288
OVERHEAD		
Janitorial	$1,017	$1,017
Heating	$261	$218
Electricity	$908	$1,275
	$2,186	$2,510
TOTAL	**$17,721**	**$18,341**

APPENDIX L (continued)

COST SCHEDULE BREAKDOWN

PRIMARY ACTIVITIES	3rd Quarter	4th Quarter
Knee Series	(114) (3.959) = $463	(89) (3.959) = $362
Hand Series	(138) (3.371) = $476	(98) (3.371) = $338
Cervical Spine	(32) (5.250) = $172	(41) (5.250) = $220
Shoulder Series	(41) (3.959) = $166	(33) (3.959) = $134
Elbow	(34) (2.494) = $87	(19) (2.494) = $49
Chest (PA)	(120) (2.586) = $316	(272) (2.586) = $716
Chest Acute	(104) (4.437) = $468	(149) (4.437) = $671
Chest Asb	(527) (4.437) =$2,378	(553) (4.437) =$2,490
Ankle	(89) (5.025) = $455	(74) (5.025) = $378
Acute Abdomen	(11) (8.199) = $80	(13) (8.199) = $95
Abdomen	(35) (5.613) = $190	(19) (5.613) = $103
	$5,951	$6,590
SECONDARY ACTIVITIES		
Training	(.033) ($12,705) = $419	(.033) ($12,705) = $419
Answering Phone	(.073) ($12,705) = $927	(.073) ($12,705) = $927
Verify & File Films	(.042) ($12,705) = $534	(.042) ($12,705) = $534
Other Direct Labor	(.641) ($12,705) = $8,138	(.622) ($12,705) =$7,908
	$10,018	$9,788
OVERHEAD		
Janitorial	$1,017	$1,017
Heating	$27	$9
Electricity	$788	$841
	$1,832	$1,867
TOTAL	**$17,801**	**$18,245**

APPENDIX M

1ST QUARTER ACTIVITY COST

	KNEE SERIES	HAND SERIES	CERVICAL SPINE	SHOUL-DER SERIES	ELBOW SERIES	CHEST (PA)	CHEST ACUTE	CHEST ASBESTOS	ANKLE SERIES	ACUTE ABDOMEN	ABDOMEN
VOLUME 1st QTR	72	65	44	46	36	281	119	517	59	12	11
COST BASIS*	.057	.044	.052	.037	.018	.144	.105	.455	.059	.016	.012
PRIMARY ACTIVITY COST	$285	$219	$231	$182	$89	$726	$528	$2,294	$296	$90	$67
SECOND-ARY ACTIVITY COST	$604	$467	$549	$385	$188	$1,511	$1,102	$4,793	$616	$164	$131
OVER-HEAD APPOR-TION	$125	$97	$114	$80	$39	$314	$229	$995	$128	$34	$27
TOTAL ACTIVITY COST	$1,014	$783	$894	$647	$315	$2,551	$1,859	$8,083	$1,040	$225	$288

* Allocation based on Patient Volume by series divided by Total Patient Volume (eg. 72/1262 = .057)

APPENDIX M (CONTINUED)
2ND QUARTER ACTIVITY COST

	KNEE SERIES	HAND SERIES	CERVICAL SPINE	SHOULDER SERIES	ELBOW SERIES	CHEST (PA)	CHEST ACUTE	CHEST ASBESTOS	ANKLE SERIES	ACUTE ABDOMEN	ABDOMEN
VOLUME 2nd QTR	105	98	41	33	19	272	149	553	74	13	19
COST BASIS*	.076	.061	.044	.024	.009	.126	.119	.441	.067	.024	.035
PRIMARY ACTIVITY COST	$416	$330	$215	$130	$47	$703	$661	$2,453	$371	$106	$106
SECONDARY ACTIVITY COST	$191	$153	$110	$60	$21	$316	$298	$4,534	$685	$247	$361
OVERHEAD APPORTION	$166	$133	$96	$52	$19	$275	$260	$1,106	$167	$60	$88
TOTAL ACTIVITY COST	$773	$616	$422	$242	$87	$1,294	$1,219	$8,093	$1,223	$414	$555

* Allocation based on Patient Volume per series divided by Total Patient Volume (eg. 105/1376 = .076)

APPENDIX M (CONTINUED)
3RD QUARTER ACTIVITY COST

	KNEE SERIES	HAND SERIES	CERVICAL SPINE	SHOUL-DER SERIES	ELBOW SERIES	CHEST (PA)	CHEST ACUTE	CHEST ASBESTOS	ANKLE SERIES	ACUTE ABDOMEN	ABDOMEN
VOLUME 3rd QTR	114	138	32	41	34	420	104	527	89	11	35
COST BASIS*	.074	.080	.032	.028	.014	.181	.077	.392	.075	.013	.031
PRIMARY ACTIVITY COST	$463	$476	$172	$166	$87	$316	$468	$2,378	$455	$80	$190
SECOND-ARY ACTIVITY COST	$769	$799	$322	$276	$143	$1,817	$774	$3,926	$749	$132	$311
OVER-HEAD APPOR-TION	$141	$146	$59	$50	$26	$332	$141	$718	$137	$24	$57
TOTAL ACTIVITY COST	$1,373	$1,421	$553	$493	$256	$2,465	$1,384	$7,021	$1,341	$236	$558

* Allocation based on Patient Volume per series divided by Total Patient Volume (eg. 114/1545 = .074)

	KNEE SERIES	HAND SERIES	CERVICAL SPINE	SHOULDER SERIES	ELBOW SERIES	CHEST (PA)	CHEST ACUTE	CHEST ASBESTOS	ANKLE SERIES	ACUTE ABDOMEN	ABDOMEN
VOLUME 4th QTR	89	148	44	40	39	323	148	665	88	12	48
COST BASIS*	.054	.077	.040	.024	.015	.126	.099	.445	.067	.013	.038
PRIMARY ACTIVITY COST	$362	$338	$220	$134	$49	$716	$671	$2,490	$378	$95	$103
SECONDARY ACTIVITY COST	$530	$756	$389	$238	$145	$1,231	$972	$4,458	$668	$130	$386
OVERHEAD APPORTION	$101	$144	$74	$45	$28	$235	$185	$831	$124	$24	$72
TOTAL ACTIVITY COST	$994	$1,238	$683	$418	$222	$2,182	$1,829	$7,779	$1,170	$260	$560

* Allocation based on Patient Volume per series divided by Total Patient Volume (eg. 89/2660 = .033)

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